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A water supply for Chicago from the Kankakee River was the subject of a paper read by Prof. J. L. Campbell, of Wabash College, before the Indiana Academy of Sciences at Indianapolis on Dec. 30. Prof. Campbell maintains that it is practically impossible to keep the present source of supply, Lake Michigan, free from impurities resulting from drainage into the lake. He advocates a 50 mile aqueduct from the Kankakee River, which would give a gravity supply with 1,200 miles of drainage area. It will doubtless be many years before Chicago abandons Lake Michigan as its source of supply.

A notable electric railway decision of the Supreme Court of the District of Columbia in the case of the inventor George F. Green has had the effect to cause the Patent Office to issue two patents covering pioneer inventions in electrical railways that may have an extensive and important bearing upon the electrical railroad interests of the country, for it is reported that these patents antedate the patents heretofore granted Prof. Hall, Stephen D. Field, Thomas A. Edison and Prof. E. W. Siemens. It appears that in 1878 Green operated an experimental railway capable of carrying passengers, but his original invention was exhibited in the winter of 1874-75 in the shape of a small model.

The Missouri State University at Columbia, Mo., was destroyed by fire in its main building on Jan. 9. The fire started from an electric light wire, and the loss is placed at $360,000, with an insurance of $130,000.

The New York Custom House, on Wall St., is offered for sale by the government at $4,000,000. The building cost the Merchants' Exchange, in 1836, $1,800,000, and the Government bought the structure for $1,000,000 in 1862. It is remarkable for its granite columns, 38 ft. high and 4½ ft. in diameter and weighing 45 tons each.

A new street sign has been patented by Mr. M. Hofheimer, of New York. It is to be placed around electric light poles, about 10 ft. from the ground, and has four faces of colored glass with translucent letters. At night it is illuminated by an enameled reflector placed behind each sign and receiving light from the electric light above it.

Street cars, 16 and 18 ft. long, are to replace the 12 and 14 ft. cars on the Villard lines in Milwaukee. The new open cars will have 8 wheels and seat 50 passengers.

The microscopic structure of steel was recently discussed at a meeting of the Amsterdam Royal Academy of Sciences. M. Behrens stated that under high powers of the microscope the network in hardened steel may be made visible on polished slices without etching or annealing, the dark sinuous lines answering to the bright ones shown by Sorby and Wedding on etched slices. It is proved that hardened steel contains hard granules bound up in a matrix of soft iron. Some varieties of gray iron from small castings may be hardened like steel, most of the graphite disappearing. After annealing the metal at a red heat, however, the slices were dotted with blackish dust, and the graphite seemed to have reappeared.

The whaleback type of vessel is claimed by its inventor, Capt. McDougall, to be well adapted to coast defense. He is now preparing plans for such a vessel which can be partially submerged by water ballast so as to leave only the smokestack and bow above water. The latter would be made very strong and would carry two heavy guns.

The New York Dock Board proposes to widen West St. by building a sea wall and adding 150 ft. to the street, thus making it 250 ft. wide. This will relieve one of the most congested streets in the city. The new president of the board, Mr. J. Sergeant Cram, advocates city ownership of docks and hydraulic plant for loading and unloading ships. He would imitate the example of the Liverpool corporation in this respect, and reduce charges of all kinds to cost with a view of attracting commerce.

English railway accidents for the nine months ending Sept. 30, 1891, are thus summarized by the Board of Trade, the tabulation being ours:

No. of cases.	Class of accident or cause.	Passengers. Killed.	Passengers. Injured.	Employees. Killed.	Employees. Injured.
33	Collisions, passenger trains....	0	214	3	18
41	" " and freight.	3	112	2	21
22	" freight trains.....	.	...	2	27
27	Derailment, passenger trains.	0	15	0	2
5	" freight trains.....	.	...	1	3
8	Switches, defective or misplaced.....	0	27	0	1
20	Entering station at too great speed.....	1	137	0	8
35	Crossing accidents.....	.	...	0	2
3	Bursting of boiler or tubes	.	...	0	3
169	Failure of axles.....	0	4	0	1
4	" of couplings.....	.	...	0	4
5	" of brakes.....	0	19	0	1
3	" of bridges.....	0	95	0	4
181	" of rails.....	.	...	0	1
6	Miscellaneous.....	0	20	0	6

The Japanese earthquake, of Oct. 28, mentioned in our last issue, caused the death of 7,520 people, wounded 6,825 more and totally destroyed 70,573 houses, according to a letter lately written from Japan. The railway between Tarui and Gifu, the center of disturbance, was rendered useless for 28 miles by the twisting of the track and subsidence.

The most serious railway accident of the week was a derailment Jan. 11 on the Louisville, New Albany & Chicago R. R. near Crawfordsville, Ind. The engine and one baggage car remained on the track, but a baggage and express car, day car, ladies car and parlor car went down a high bank and were all wrecked. The day car rolled over and over in its descent, and caught fire from the overturned stove, but though it was full of passengers none of them were killed. There were 2 persons killed and 37 injured, some of them very seriously. A rear collision between two Lehigh Valley trains occurred in the Erie R. R. yard at Castile, N. Y., Jan. 12, by which two men in the caboose were killed. Ten cars were wrecked and five of them, loaded with oil, caught fire, the wreck and the bodies of the two men being consumed.

A burned bridge near Sentinel Butte, N. Dak., on the Northern Pacific R. R., gave way under a double-header stock train Jan. 5. Both engines and one car went through and one man was killed and another injured.

A cave-in over the Pardee mine at Hazleton, Pa., Jan. 12, has affected nearly a square mile of the surface in or near the town. Water and gas mains are broken and many buildings cracked, while fissures have opened along some of the streets. The passenger trains of the Lehigh Valley R. R. have been stopped from running across the town. The disaster is said to have been caused by robbing or removing the pillars which support the roof of the mine.

According to the Interstate Commerce Commission's Report, presented to Congress on Jan. 5, the railways have shown an increasing disposition to comply with the law during the past year. Unjust discrimination in favor of particular persons, places or kinds of business, is becoming less frequent; but little improvement has been made in the observance of the section requiring the establishment and publication of rates. The report of the Committee on Uniform Classification has not been put in force, on account of the opposition of a few of the railways, but the Commission is as fully convinced as ever of its desirability, and urges that its adoption be made compulsory.

In our issues of May 16 and June 13, 1891, an account was given of the ordinances passed by a "combine" in the city council of Plainfield, N. J., giving franchises for water-works and sewerage systems to J. M. Low, of Kingston, N. Y., and others. These franchises were granted against the wishes of a majority of the best citizens and heaviest taxpayers, who objected to the sewerage franchise, especially on account of its indefiniteness regarding the method of sewage disposal to be adopted. Both ordinances were railroaded through the council and finally passed over the mayor's veto. A new council has just been elected, ousting the "combine." At its first meeting the advice given in the inaugural message of Mayor A. Gilbert was acted upon and steps were taken to repeal both franchises, no work yet having been done under either. This action will leave the present water company in possession of the field and will prepare the way for the construction of a carefully designed sewerage system. The latter is greatly needed, as Plainfield had a population of 11,267 in 1890, not including suburbs, and is growing rapidly.

The Long Bridge, over the Potomac at Washington D. C., is before the public again, in the form of a bill submitted to Congress that, it is claimed, would give to the Baltimore & Potomac Ry. Co. returns in land now occupied by a carriage way, out of proportion to the required expenditure of $25,000 for bridge improvement. Meanwhile the old bridge would remain as an obstruction in the river and over the flats. The plans of Col. Hains, late Engineer Commissioner of the District, called for a two-span structure with viaduct approaches on a new line across the river, and the Commissioners have now withdrawn their approval of the bill submitted to Congress, and will carefully review the whole bridge question at this point.

A lighthouse at Old Orchard Shoal, in the Lower Bay, New York Harbor, is to be let on Jan. 28. The plans that are issued by the Lighthouse Board are the fullest as to details that we have ever seen. These and the specifications, etc., can be obtained at the office of Major D. P. Heap, U. S. Engineers, Tompkinsville, N. Y. The lighthouse will be founded on gravel on a cast iron cylinder 33 ft. in diameter and 34½ ft. high, filled with concrete, with a trumpet shaped extension 10½ ft. high. The focal plane of the lantern will be 82 ft. above the bottom of the cylinder, or about 59 ft. above high water. The minimum depth at low water is 17½ ft.

Elevated sidewalks are proposed by Mr. T. J. Nicholl, a civil engineer of Chicago, for relieving the congested condition of the streets in the business district. Light steel trusses would be supported on the flared tops of steel columns planted on the curb line, with bridges crossing the streets, leaving 16 ft. headroom beneath. Steel stairways at the corners of streets would furnish access to the footway, and connection can be made with the second floor of stores when desired. The estimated cost is $10 to $15 per lineal foot of structure, and 84,480 ft., or 16 miles, would be required to cover the district. Mr. Nicholl estimates the enhanced value of frontage to business blocks at $400 per lineal foot.

The electric railway cases of Newark and Trenton have given rise to considerable complication. Justice Reed, of the New Jersey Supreme Court, has ruled that while the Trenton Councils could grant to a corporation power to use motors on the streets, they could not give permission for the erection of structures on the curb line to convey the electric fluid to the motors. The Justice is of the opinion that it never was the intention of the Legislature to empower a corporation to change its system. The Newark Councils simply passed a resolution granting certain privileges to an electric railway company. Justice Reed raises the same points against the Newark resolution that he did against the Trenton ordinance. These cases involve the right of corporations to erect poles in the streets for conveying electric power.

The Jeddo tunnel, near Hazelton, Pa., has made good progress in 1891 under the present contractors, Messrs. Charles F. King & Co. This tunnel is intended eventually to drain into Butler Valley the water that for a long time has flooded the Jeddo and Ebervale collieries. At the Butler end the tunnel is now driven 650 ft. and this will be arched 8 ft. by 8ft. About 5,000 ft. south of the approach a slope has been driven 400 ft., but must be sunk 350 ft. more. At Ebervale the slope is 1,300 ft. long, through rock, and is about down to the tunnel level.

The late trial of the monitor "Miantonomoh" was generally very satisfactory. The 10-in. guns worked well with no undue shock to the ship or the gun carriages. The full charges of 250 lbs. of powder and 500-lb. projectile were used and 20 shots were fired. The ship behaved well in the heavy sea running.

The Chicago elevated terminal scheme seems to be assured. This means the construction of 15 miles of elevated road in three trunk line systems, converging in a four-track elevated structure running to a station at the corner of State and Twelfth Sts. The station will be 250 ft. by 235 ft. and eight stories high, to be occupied by the general offices of the tenant companies. The trainshed is to be 600 by 250 ft., with 12 hydraulic elevators. Each company would have an 8-story warehouse into which cars could be shunted and lifted to any floor by elevators. Transfer tables, somewhat on the European plan, are contemplated. The estimated cost of the elevated road is $500,000 per mile; the requisite land will cost $7,500,000. No estimate is given for the station. Gen. Joseph T. Torrence is president of the terminal company and he thinks that 80% can be saved to Chicago railways in their terminal expenses by the use of his system. This project was described more fully in our issue of Jan. 2.

THE WORLD'S COLUMBIAN EXPOSITION.

The readers of Engineering News will naturally look to it for a tolerably full description of all the features of technical interest in the great World's Fair at Chicago, for which preparations are now so far advanced. This means a pretty full description of all the plans, buildings and traffic arrangements of the fair, as well as of the exhibits themselves. We do not intend that they shall be disappointed in this reasonable expectation, and begin with this issue the publication of a series of articles which will probably run during the next two years, and in which we hope to give, not indeed a full description of everything deserving it, for to do so would require several volumes, but sufficiently full descriptions of all the more salient features and exhibits to enable busy men to feel that they are keeping fairly good track of what the great fair has to teach them, without troubling themselves to wade through the pages of wordy description which from now until the end of the exposition will fill the daily press. This series of articles will not, of course, be continuous, nor will it be intended as in any sense a substitute for personal observation; but it is hoped to record the facts of moment which cannot be detected by the casual visitor and to guide him in seeking for what will interest him most, and also to give much general and detailed information respecting matters of technical interest.

Location of the Grounds.

The location of the "World's Columbian Exposition," to be held at Chicago in 1893, is at Jackson Park, the whole area of which will be occupied. This park (see Fig. 1) is situated on the shore of Lake Michigan, and extends from 56th St. to 67th St., a distance of about 7,000 ft., while its width is about 1,700 ft. on 56th St. and 5,000 ft. on 67th St. The distance from the center of the city is about 7 miles. The distance from "Grand Crossing," a well known point to travelers approaching Chicago from the east, is only about 1½ miles. A new line is to be built from near Grand Crossing to the park, as shown by the dotted line, and this will afford access for a number of railways. The total area of the park is about 500 acres, of which 120 acres at the northern end will be devoted to the buildings of the states and foreign countries, and 60 acres at the southern end will be devoted to the live stock exhibit. The general arrangement of the buildings and grounds is shown in the accompanying plan, Fig. 2. In addition to the park itself, the exposition site will include the Midway Plaisance, an open piece of land 600 ft. wide and about a mile in length, extending back from the park between 59th St. and 60th St., and there will be located the model streets of foreign cities and other exhibits of a special character, concessions for several of which have already been granted. The total area of the exposition grounds will be about 660 acres. The site of the proposed tower, 1,020 ft. high, illustrated in our issue of Dec. 5, 1891, is shown on Fig. 2.

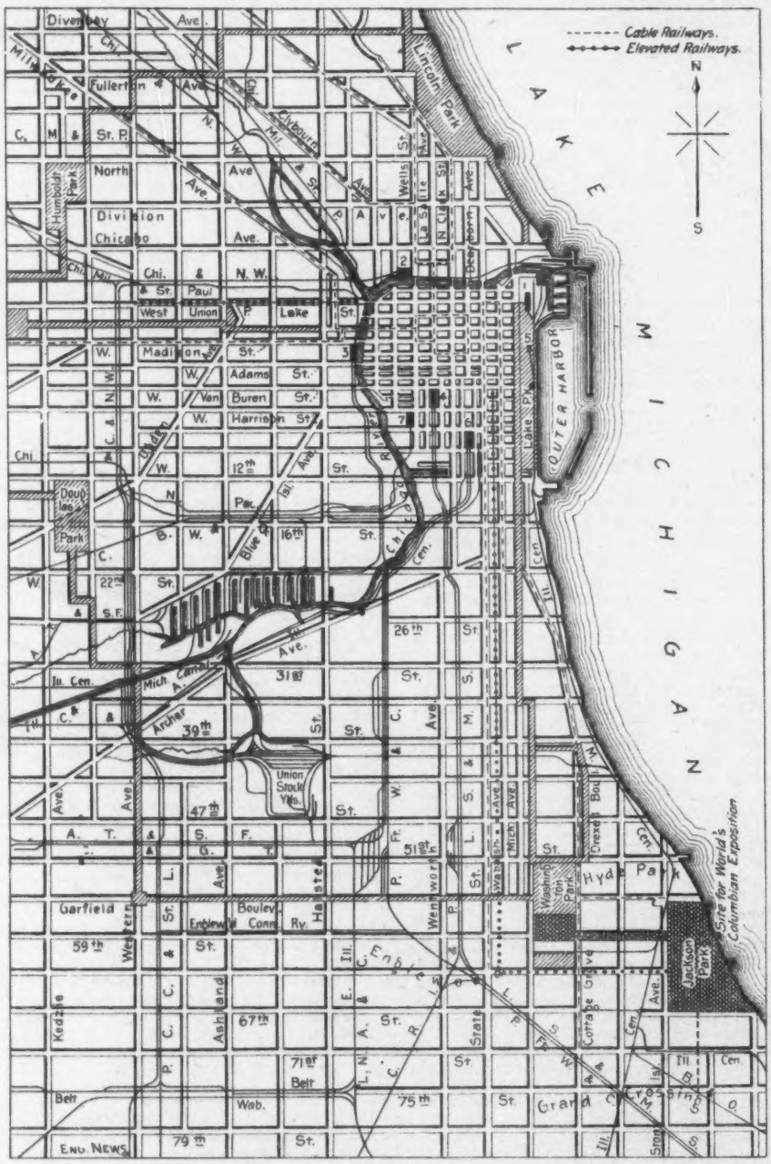


FIG. 1. MAP OF CHICAGO, SHOWING THE LOCATION OF THE WORLD'S COLUMBIAN EXPOSITION.

Construction Department.

The following is a list of the names of the heads of the different departments in the Bureau of Construction:

D. H. Burnham, Chief of Construction.
E. R. Graham, Assistant Chief of Construction.
Chas. B. Atwood, Designer in Chief.
Dion Geraldine, General Superintendent.
E. C. Shankland, Engineer of Construction.
F. O. Cloyes, Chief Draftsman.
Wm. Prettyman, Director of Color.
W. S. McHarg, Engineer of Water Supply, Sewerage and Fire Protection.
F. Sargent, Electrical Engineer.
J. C. Slocum, Mechanical Engineer.
E. G. Nourse, Engineer of Railways.
J. W. Alvord, Engineer of Surveys and Grades.
W. D. Richardson, Superintendent of Exterior Covering.
R. Ulrich, Superintendent of Landscape Department.
F. L. Olmsted & Co., Landscape Architects.

Buildings.

The construction of the buildings will include some very heavy and interesting iron work in roofs, domes, trusses, etc., details of which we will give later. The general exterior framing and lighter construction is of wood, which will be covered with "staff," a material much resembling plaster in its application but vastly more durable, and a large amount of the paneling and decorative work will be of the same material. The composition and manufacture of this material are described further on. The color of the buildings is under the charge of an expert, Mr. Wm. Prettyman, who is to devise an artistic and harmonious scheme of coloring. It is stated that each building will be given an individual effect, but such as to harmonize with the general treatment. The dimensions and areas of the buildings, with their estimated cost, are given in the following table. The United States Building and the model of the battleship are being built by the U. S. Government, and the Illinois Building by the state of Illinois, but these are all among the leading features of the exposition buildings. The annexes of the Fine Arts Building will probably be larger than indicated in the table, and the arrangement of the Casino has also been somewhat altered since the original plans were prepared. The plan in Fig. 2 has been prepared from the latest official plan, and shows the arrangement as at present contemplated.

Buildings.	Dimensions in feet.	Area in acres.	Cost.
Mines and Mining	350 × 700	5.6	$250,000
Manufactures and Liberal Arts	787 × 1,687	30.5	1,000,000
Horticulture	250 × 1,000	5.8	300,000
Electricity	345 × 700	5.5	375,000
Woman's	200 × 400	1.8	120,000
Transportation	250 × 960	5.5	280,000
Administration	260 × 260	1.6	450,000
Fish and Fisheries	163 × 363	1.4	200,000
Annexes (2)	135 diam.	0.8	
Agriculture	500 × 800	9.2	540,000
Annex	328 × 500	3.8	200,000
Assembly Hall, etc.	440 × 500	5.2	
Machinery	500 × 800	9.8	1,200,000
Annex	490 × 551	6.2	
Power-house	80 × 600	1.1	
Fine Arts	320 × 500	3.7	500,000
Annexes (2)	120 × 200	1.1	
Forestry	200 × 500	2.3	100,000
Saw Mill	125 × 300	0.9	35,000
Dairy	95 × 200	0.5	30,000
Live Stock (3)	53 × 330	1.3	150,000
Live Stock Sheds		46.0	
Casino	175 × 360	1.2	150,000
		144.8	$5,890,000
U. S. Government	350 × 420	3.4	400,000
Battle Ship	348 × 69.25	0.2	160,000
Illinois State	160 × 450	1.7	250,000
		150.1	$6,640,000

Including cost of pier.

All the main buildings are to be completed by October, 1892, and several are expected to be completed by May, 1892. The work will be carried on through the winter, the force varying from 1,000 to 4,000 men employed on the buildings and grounds. The following particulars as to the several buildings, compiled partly from notes taken on the grounds, will give an idea of the extent of the progress which has been made thus far, and the work is advancing steadily. Large amounts of material are on the ground. Up to Jan. 1, 1892, there had been 3,433,453

lbs. of ironwork delivered, 1,659,350 lbs. of ironwork were erected, and 30,000,000 ft. of timber used in construction.

Manufactures;—350 × 700 ft. Piles are being driven, main posts and caps for floors placed, and floor beams and planking are being laid.

Machinery;—500 × 800 ft. The timber work of the foundation and the capping and framing for floor is nearly completed and the roof trusses are being erected. The erection of the dome has also been commenced, for which work an electric hoist is to be used.

Art;—320 × 500 ft. The foundations are nearly completed, and the brick walls are being built.

Mines and Mining;—350 × 700 ft. The great steel roof is erected, and the greater portion of the exterior timber construction is completed and being vanced, the lower part of the main construction being nearly finished. The 64 combination trusses of the gallery roof have been erected, and the sheathing and skylights put on. The steel trusses of the center roof are being erected.

Electricity;—345 × 700 ft. Work is in progress on the main timber columns, and has been commenced on the erection of the steel arches, 115 ft. span., for

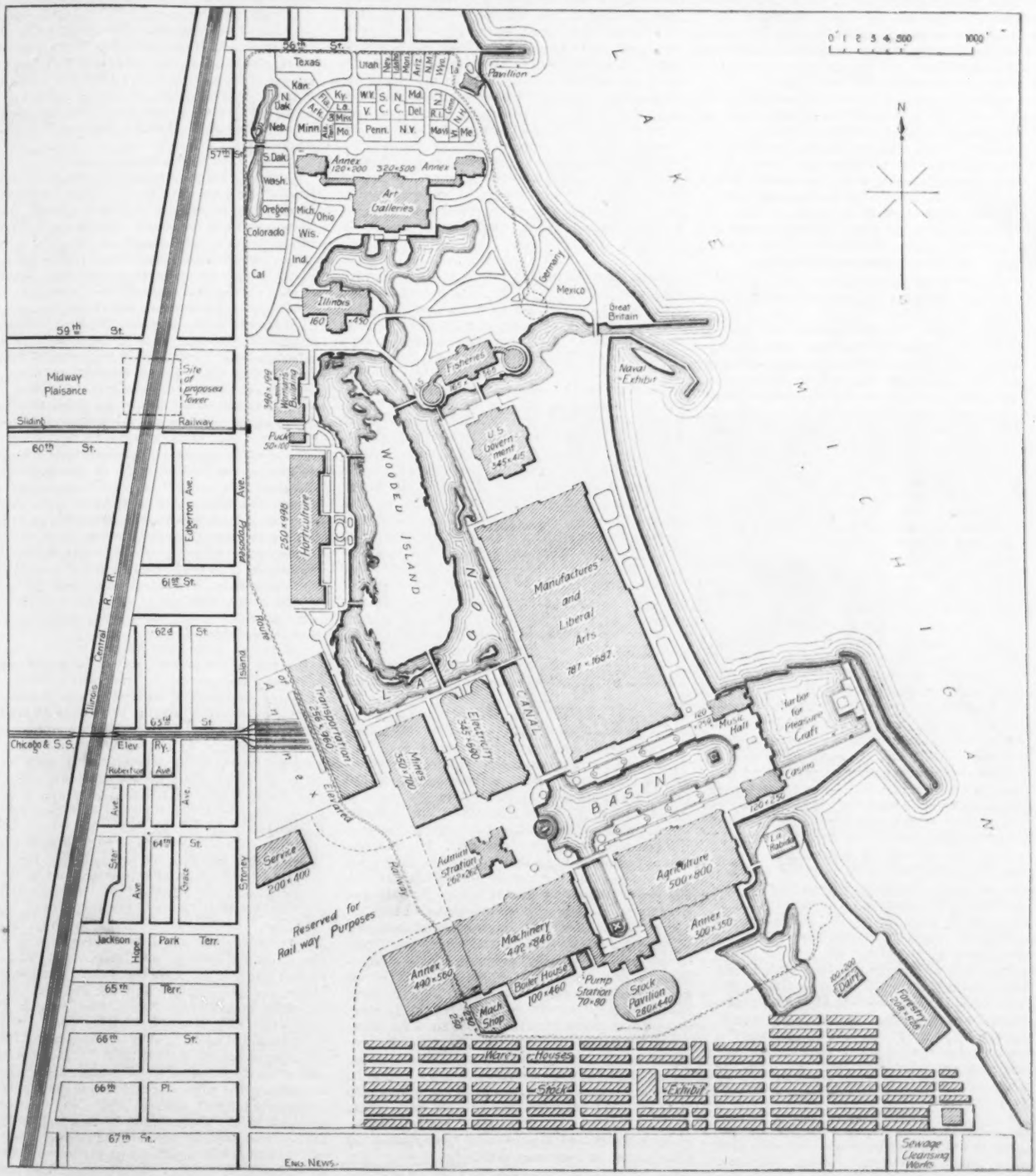


FIG. 2. MAP OF THE WORLD'S COLUMBIAN EXPOSITION.

work are in progress. The foundations for the annex are being built.

Agriculture;—500 × 800 ft. The flooring is laid and the main wooden columns and gallery girders are being erected. The iron roof columns are also being placed.

Horticulture;—250 × 1,000 ft. This will be mainly of wood, with an iron dome. The exterior main framing made ready for the exterior "staff" covering, some of which is already in place. The floor is laid and the roofing being put on. A movable shed about 6 ft. deep and heated by stoves will be built against the wall of the building to allow the work of placing the staff covering to be carried on during cold weather.

Transportation;—250 × 960 ft. This is well ad- the nave and transept, for which a derrick 120 ft. high has been put in.

Forestry;—200 × 500 ft. Work has been commenced, and the construction is to be entirely of wood. There is practically no ironwork used, in the shape of rods or bolts or any heavy iron, but of course there are nails.

Woman's;—200 × 400 ft. This is a wooden build

ting, and is practically completed as to the exterior, the walls being covered with "staff" and a large amount of decorative work in place. Many of the interior partitions are lathed ready for plastering, and the floors are being laid. The roof and skylights are completed. The building has a very attractive appearance, and promises well for the general appearance of the completed buildings.

Administration;—260 × 260 ft. The four corner pavilions, which are of wood, are nearly completed, and some of the exterior covering is in place. The supports of the great steel dome are completed to a height of 170 ft.

Fisheries;—163 × 363 ft. The main timber construction is nearly completed to the second floor, and a large amount of iron work for columns and roof trusses is on the ground and being erected.

Government;—350 × 420 ft. The timber work for the foundation and main floor is under construction.

Battleship;—The brick hull is practically completed, but has not had the exterior covering put on. The framing of the turrets is in place. This full size model of the latest style of battleship of the U. S. navy is being erected in shallow water close to the beach, and will be approached by a pier.

"Staff" Covering and Decorative Work.

As already mentioned the exterior covering and decorative work will be of "staff," a material much resembling plaster. This material was first used at the Paris Exposition of 1889, and gave very satisfactory results. Mr. E. R. Graham, Assistant Chief of Construction, informs us that staff is practically a cement mortar made from various kinds of native cement, such as Utica, Milwaukee and Acme. Instead of using hair, a jute fiber is used, and the material may be termed a cement plaster with a strong jute fiber. There is no patent on it, and no two contractors make it exactly the same way.

For the decorative work, a full size model of the figure or design is made in Chicago clay, all the details being carefully worked out. This is then placed in a frame and a glycerine compound poured over it, forming an elastic mold in which the staff castings are made. The reason for using this compound is that owing to its elastic nature it permits of deep undercutting and gives a sharpness of outline and relief to the casts. When the mold is thoroughly cool and dry it is taken from the clay model and used for the casts. For this purpose it is first well coated with a mixture of plaster of paris and jute to a thickness of about one inch, in order to form a smooth, even exterior face to the cast and behind this is worked in the cement plaster and jute to the desired thickness, the interior being hollow. The casts are made in all sizes. The material is light in weight, but very strong owing to the use of this jute fiber. It allows of very elaborate and bold treatment, and can be painted or colored as desired, the surface taking color readily. The finished surface of the cast is white. In the construction of the wooden exterior walls of the buildings, projections are built to conform to the intended columns, cornices and other decorative effects. Lathing is then nailed on, and covered with a rough coating of plaster or staff, which forms the backing of the decoration. The casts of columns, panels, etc., are attached by screws to the timber framing. There will be required 83,328 pieces, and up to Jan. 1, 1892, there were 28,550 of these pieces cast. Three firms have contracts for the covering of the buildings, and during December, 1891, they had an average of 365 men per day at work. In the molding room the manufacture of decorative details from staff is progressing rapidly, and, judging from the work already completed and in place, very good results may be expected.

Grounds.

At the northern section of the park the general arrangement has already been laid out, and sites allotted to many States and foreign countries. Great Britain has been allotted a very commanding position on the lake front, as shown by the plan. In this section the ground has been staked out, driveways are being made and avenues of trees planted. During November over 1,200 trees and shrubs were removed, being replanted in new locations. On the main portion of the grounds, in the neighborhood of the main buildings, no work can yet be done, as that portion is occupied by camps, barracks, construction material and plant, and is cut up by roads and railway tracks. There are already about 14 miles of construction tracks. The lake front at the northern end of the park has a paved rip-rap slope surmounted by a broad promenade and driveway, and this construction will be continued as far as the main pier and harbor. The dredging of the lagoon, canal and basin is nearly completed, and the piling is being driven and timber construction built for the water front walls in front of the main buildings along the lagoon and canal. The grading of the wooded island is practically completed, this work being done by McArthur Bros., who use a narrow gage track and side dump cars. This island will be kept almost entirely free from exhibits, the purpose being to reserve it as a comfortable and attractive resting place, free from noise and bustle. This idea is an excellent one, and if carried out will add greatly to the pleasure and comfort of visitors, who are liable to become tired of the endless display and crowd in and around the buildings. The island will have natural shores and the waterways will be crossed by bridges, having a headway of 18 ft. Considerable preparations are being made already for the floral decorations of the grounds.

Water Supply.

The main water supply will be taken from Lake Michigan, through the Hyde Park tunnel, and will be pumped by the city pumping works at Hyde Park. The management will put in a Gaskill pumping plant 24,000,000 gallons daily capacity and pay the city a stated price per 1,000,000 gallons. At the close of the exposition the city will refund to the company the amount paid for the pumps. In addition to this the management has put in a plant of four Worthington pumps, with a daily capacity of 40,000,000 gallons, which will take water from the lagoon for supplying steam boilers and the fountains. In case of fire or break down of the city pumping works these pumps would furnish the complete supply. The total pumping capacity will therefore be 64,000,000 galls. per day. The present total pumping capacity of the city of Chicago, for an area of 180 sq. miles, is 280,000,000 galls. per day, but the new tunnel for furnishing the additional amount is not yet completed, the present actual supply being about 250,000,000 galls. per day. As above noted, the city will acquire the World's Fair pumping plant of 24,000,000 galls. capacity after the close of the exposition, which will increase the capacity of the city's plant to 284,000,000 galls. per day.

A 36-in. main will bring the water from the Hyde Park pumping station north to Machinery Hall, in the grounds, where it will connect with two 30-in. mains, running along each side of the grounds. Each main building will be supplied by a pipe not less than 8 ins. diam., with 6-in. pipes across the building at intervals of 300 ft., and double nozzle fire hydrants will also be placed at intervals of 300 ft. Within the walls of each building, and about 150 ft. apart, will be standpipes reaching to the roof, and having hose connections on each floor, gallery and roof. The pressure will be ample for fire protection. As an additional precaution against fire, connection will be made with the lagoon, for use in case of emergency only, and a pumping station will be established near Machinery Hall. There will be about 20 miles of pipe required for this service, and the work is about half completed. The present temporary supply is taken from the city mains, with a pressure of 30 lbs. for general use, and a plant of three Worthington pumps has been put in. In addition to the regular pressure water can be taken from the lagoons and a fire pressure of 100 lbs. maintained. The temporary fire protection now on the grounds consists of one steam engine, with 4 city fire companies always on call; 3 chemical engines, 24 hose carts, 12,500 ft. of hose, 400 hand chemical extinguishers and 700 brine pails. The total cost of the water supply system will be about $230,000 and the amount appropriated for water supply and sewerage is $650,000.

Sewerage.

All the water from the 130 acres of roof area will be discharged directly into the lagoon, this water not being polluted, and there will be about nine miles of sewer pipe 8 to 15 ins. diam. for this purpose. This work has been practically completed at a cost of $16,000. All surface water, while not seriously polluted, will contain enough dust and other matter to make it inadvisable to discharge it into the lagoon, and it will therefore be conveyed through a system of vitrified sewer pipes into wells conveniently located, whence it will be pumped directly into Lake Michigan.

The sewage proper, from closets, lavatories, kitchens, etc., will be disposed of by the Shone hydropneumatic system, being discharged by Shone ejectors and forced by compressed air into tanks, where it will be chemically treated, so that the suspended matter and a large proportion of the organic matter in solution will be precipitated. The clear water will then be pumped to the lake, while the sludge will be compressed into cakes and burnt in the furnaces in Machinery Hall. There will be four sewage tanks, each 32 ft. diam. and 31 ft. high, on a base 22 ft. high. The plant will have a capacity of 6,000,000 gallons of sewage per day and will cost about $165,000. The total cost of the sewerage system will be about $230,000, exclusive of sewage disposal.

Closets and Lavatories.

A contract has been awarded to James B. Clow & Son, of Chicago, for the placing of 3,000 water closets, 2,000 urinals (which seems a small number in proportion to the water closets) and 1,500 lavatories, involving an expenditure of about $500,000. About two-thirds of the fixtures will be placed in toilet rooms in connection with the buildings erected by the management, and about one-third will be placed in separate buildings designed and to be erected for the purpose. These buildings will be located in various parts of the grounds, as best suited for public convenience, and will each contain from 50 to 100 closets, with lavatories. There will be 31 toilet rooms for men and 31 for women. All the rooms will be in charge of competent attendants, and the fixtures will be kept in good order. It is stated that about a third of the closets and urinals will be open to the public free of charge. No decision has yet been made as to what or whose materials will be used, but it is probable that different toilet rooms will be fitted up with the fixtures made by different manufacturers, and some firms may perhaps make arrangements to equip each an entire building with their own fixtures and specialties. The plans provide for a very complete sanitary system, and subcontracts will be let for plumbing, etc. The closets, etc., will be connected with the water supply and sewerage systems already referred to.

Electricity.

We can as yet give but a brief, imperfect notice of the enormous electric lighting plant, which will be one of the grandest features of the exposition, and on a very much greater scale than at any previous exposition. All the buildings are to be supplied with electric light, and the plans have been prepared for the fitting of several of the main buildings, involving about 7,000 arc lamps of 2,000 c. p. and 120,000 incandescent lamps of 16 c. p. Most of the buildings will have arc lights, but they will all be wired for incandescent lights for the use of exhibitors. Of arc lights there will be 2,000 in the Manufactures Building, 600 in Machinery Hall, 600 in the Agricultural Building, 400 each in the Electricity, Mining, and Horticultural buildings, 450 in the Transportation Building and 150 in the Forestry Building. The Fine Arts Building will have about 12,000 incandescent lamps for its one mile of wall space, and will have no arc lights. The Administration Building will have about 10,000 incandescent lamps, and the Woman's Building will have 180 arc and 2,700 incandescent lights. The grounds will also be lighted by electricity, but the plans are not yet determined upon. Power will also be furnished for electric motors of 16 to 250 HP. The cross section of the electrical subways through the grounds, for carrying the wires and cables, was illustrated in Engineering News, Oct. 31, 1891. The estimates prepared by Mr. Sargent, the Electrical Engineer, are said to show that twice as many electric lights will be used in the buildings as are now in use in the entire city of Chicago. The plans call for ten times the capacity of all the plant at the Paris Exposition of 1889. The management will spend $1,000,000, and perhaps more, for the electric plant. Exhibitors will not be required to pay for light, except in cases where they call for more lamps than are furnished by the Construction Department. In that event they will be furnished additional lamps at actual cost.

Intramural Railways.

The arrangements for railway facilities within the grounds are not yet completed, but there will

be a line running the whole length of the grounds. This is intended to be a double track elevated road, with a loop at each end, and the probable route is shown upon the map, Fig. 2, but this is not yet definitely settled. It is said that there will be in all about 5 miles of intramural railways. There will probably be an elevated line of the Multiple Speed & Traction Co.'s movable sidewalk (Eng. News, Dec. 31, 1890, and June 27, 1891), an experimental section of which, with two traveling platforms, is now in operation at the park. This experimental section is a continuous line on a timber trestle, 900 ft. long, with curves and tangents and a total curvature of 380°. There is a stationary platform on the outer side, a narrow traveling platform for pedestrians next to it, and a wider traveling platform moving at double the speed on the inner side. This inner platform is provided with transverse seats, having accommodation for 900 passengers. The slow speed platform has posts at intervals along the edge to aid persons stepping on and off. The speeds are about 2½ and 5 or 3 and 6 miles per hour. The platforms are driven by electric motors on three of the carrying trucks, power being supplied by an engine of 125 HP., of which only 40 HP. is required. Cut-out switches are placed at intervals, by means of which the platforms can be stopped at once. The weight of platforms, or rolling load, is about 320 lbs per lin. ft. The capacity is said to be about 40,000 persons per hour past a given point. The company, of which Mr. Max E. Schmidt is the engineer, proposes a line in the Exposition grounds, 2¾ miles long, to be an elevated structure of steel with a single row of columns, and at an average elevation of 10 ft., but to be carried across the Transportation annex.

Along the south side of the Midway Plaisance will be a hydraulic sliding railway or "chemin de fer glissant" (Eng. News, Aug. 31, and Oct. 26, 1889), a mile long, with one track for through trains and one for way trains stopping at three intermediate stations. Propositions for the construction of an iron elevated structure, and its equipment, and the operation thereon of a method of transporting visitors about the grounds, will be received until March 1 by Mr. D. H. Burnham, Chief of Construction. The structure will have about 5½ miles of single track, with about 24 passenger stations and the necessary terminal storage yards and sheds for the equipment.

Ironwork Contracts.

Mr. E. C. Shankland, M. Am. Soc. C. E., Engineer of Construction, has furnished the following list of the principal contracts for the ironwork of the main buildings: Mines and Mining Building; King Iron Bridge & Mfg. Co., of Cleveland, O.; $57,525. Electricity Building; trusses sublet by the general contractors to the Kenwood Bridge Co., of Chicago; $63,000. Manufactures and Liberal Arts Building; steel trusses for the courts let to the Edge Moor Bridge Works, of Edge Moor, Del., at 4·1 cts. per lb.; estimated total, $410,000. Horticultural Building; ironwork of dome sublet by the Probst Construction Co., of Chicago, to Binder & Seifert, of Chicago; $30,140. Fisheries Building; Keystone Bridge Co., of Pittsburg, Pa; $20,210. Administration Building; contract for dome let to A. Gottlieb & Co.; $55,000. Machinery Hall; sublet by Binder & Seifert to Cofrode & Saylor, of Philadelphia, Pa., at 3.698 cts. per lb.; estimated total, $335,000. Fine Arts Building; A. Gottlieb & Co.; $51,490. Approximate total, $1,022,275. There are also combination trusses in all the buildings, but these were let in the contracts for carpenter work and sublet to different companies.

Glass.

In the skylights of the 12 principal buildings there will be about 23½ acres of glass, all of a uniform thickness of $\frac{1}{8}$ in. This will be equal to about 120 carloads. The area for each building will be as follows:

Manufactures	474,339	sq. ft.
Machinery	217,455	"
Agricultural	147,450	"
Horticulture	107,460	"
Fine Arts	88,036	"
Mines	68,450	"
Transportation	65,228	"
Electricity	50,400	"
Forestry	21,480	"
Women's	11,550	"
Administration	1,436	"
Fisheries	1,248	"
Total, 26.5 acres	1,254,218	sq. ft.

Concessions.

The Ways and Means Committee has reported the following list of concessions granted up to Dec. 17, and most of the special exhibits thus provided for will be established in the Midway Plaisance. In addition to those already granted the committee is considering concessions providing for a Japanese theater, Japanese colony, and Korean attractions:

George Pangalo, of Cairo, Egypt; providing for the representation of a street in Cairo (Eng. News, June 27, 1891).

Elia Souhami Sadullah & Co., of Constantinople, Turkey; providing for a Turkish attraction, including the sale of goods.

W. L. Libbey & Son Co., of Toledo, O.; to erect a glass furnace and illustrate and sell American glassware, except window and plate glass.

Hilmar Stephany, of New York; providing for a Moorish palace, with cafés and other features, and the exhibit of $1,000,000 in gold, "provided the same can be secured."

Keppler & Schwarzmann, publishers of "Puck," New York; permission to construct a building about 60 × 100 ft., and show the entire work of producing that paper.

The Barre Sliding Railway Co.; providing for the erection of a hydraulic sliding railway, extending the entire length of the Midway Plaisance, along its southern boundary, as above referred to.

Financial Estimates.

The management has this month issued a report in which are given some interesting figures in regard to the expenditures and resources. The estimated expenditures are as follows:

Grading, filling, landscape gardening, viaducts and bridges, and waterway improvements	$1,193,800
Railways	500,000
Steam plant	800,000
Electric plant	1,500,000
Statuary on buildings	100,000
Water supply and sewerage	600,000
Improvement of the lake front	200,000
World's Congress Auxiliary	200,000
Construction Dept.; expenses, fuel, etc	520,000
Organization and administration	3,398,653
Operating expenses during the exposition	1,550,000
Other expenses	58,000
Total	10,570,453
Buildings	8,000,000
Grand total	$18,570,453

The estimated resources are as follows:

Prospective gate receipts	$10,000,000
Stock subscriptions	3,721,230
City of Chicago bonds	5,000,000
Concessions and privileges	1,500,000
Salvage	1,500,000
Interest on deposits	33,000
Total	$23,754,230

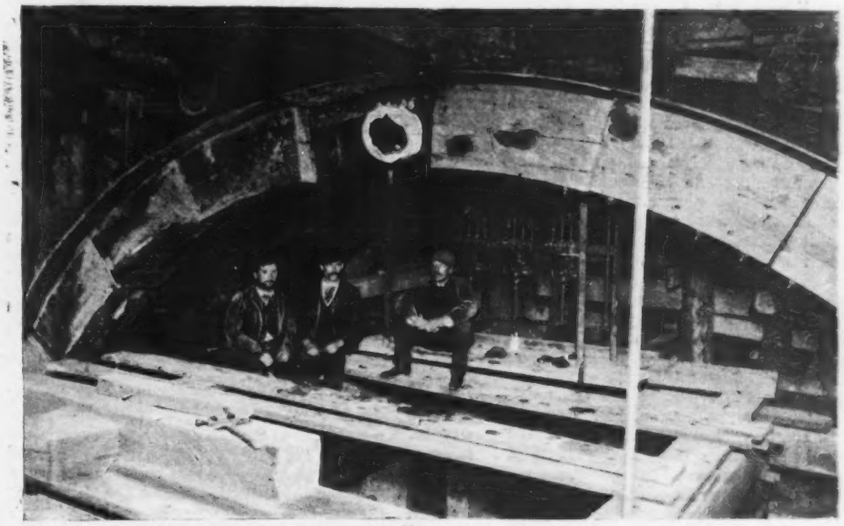
Of the total expenditures about $17,000,000 must be paid out before the opening of the exposition on May 1, 1893. The total amount expended up to January, 1892, was $2,779,707, and owing to the present enormous demands for construction, the monthly expenditure now averages nearly $1,000,000. To the resources may be added about $200,000 for future interest on bank deposits, and for future subscriptions to the stock, as such subscriptions are coming in steadily. On the other hand, however, a deduction of 7 or 8% on the subscriptions for stock must be made for delinquency in payment. There are about 30,000 subscribers, and 60% of the subscription has been called for and about $3,433,800 paid in.

The resources, as estimated, stand in round numbers, $23,350,000, or about $4,825,000 in excess of the total estimated necessary expenditures, but of the resources the gate receipts, concessions and privileges and salvage, representing a total of $13,000,000, are not only estimates, but are necessarily prospective. They cannot be realized even in part until the exposition opens and is in progress. The salvage from the disposal of the buildings cannot, of course, be realized until after the exposition closes. The resources available previous to the opening of the exposition, by which time, as explained above, about $17,000,000 must be expended, are therefore about $10,250,000, and about $5,250,000 must be provided for. If Congress makes the desired grant of $5,000,000, as it is hoped it will, this will about meet the requirements of the case.

The management has placed a fire insurance of $1,078,678 to cover the buildings, statuary and electric plant.

ROOF SHIELD USED IN YORK ROAD TUNNEL, BALTIMORE BELT RAILROAD.

We give herewith a perspective view of the semi-circular roof shield used in driving the York Road



ROOF SHIELD IN USE AT YORK ROAD TUNNEL, BALTIMORE BELT RAILROAD.

Tunnel of the Baltimore Belt Railroad, the working drawings of which were given in our last issue. One of the segment timbers at the rear of the shield has been removed, showing the tail of the jack. The jacks were at first wrapped with canvas, as shown, to prevent any sand from sifting on them and causing cutting and leakage. Afterward it was found that no sand sifted in, and the canvas was removed. The cocks controlling the hydraulic jacks are seen in the background, and on the under surface of the shield. Since the photograph was taken from which our engraving is made, the arch has been turned in the shaft, and the work has been advanced so that the rear of the shield is about 40 ft. from the shaft.

In pursuing its forward course the shield will pass directly under a large brick building 3 stories high. The top of the shield will just miss the foundations of the building, and it is hoped to carry it through without disturbing or injuring them. As the material now being penetrated is a compact sand which stands up very well, the chances for success seem to be fair.

The great reservoir at Paris for the storage of water from Avre and Vigne near St. Cloud is nearly completed. Its elevation is nearly 351 ft. It consists of three parts, with a total capacity of 300,000 cu. m. An aqueduct across the Seine of 630 ft. length, which will also be used as a foot bridge, is under construction. It is expected to have the Paris water-works completed by May, 1892.

THE BLOCK SIGNAL SYSTEM OF THE PROVIDENCE & WORCESTER RAILROAD.

In the latter part of the year 1881 it was determined by the management of the Providence & Worcester Railroad, influenced chiefly by the advice of their enlightened and progressive superintendent, Mr. W. E. Chamberlain, to begin the equipment of the entire main line of that road, a little less than 44 miles of double track, with what they were advised by their superintendent, who had taken some trouble carefully to investigate the matter, was the most perfect system of block signals in existence, as many still believe, and with no small grounds in their favor. This system was the Union Switch & Signal Co.'s automatic track circuit signals, which has been fully described in past issues of this journal (see general index). It is also described on p. 209 of the company's Reference Book. A part of these signals only were at first ordered, and their operation began April 1, 1882, but all were put in in accordance with a definite plan for equipping the entire line, which latter was completed in 1883, as will be seen from the report below. At the end of this latter year the Providence & Worcester had 67 signals in use and 36 more in process of installment, making 103 signals in all, which equipped its entire road, making it the first road on this continent to equip and operate its main line throughout with automatic block signals. The Pennsylvania road was then, and had been for many years, operated under the absolute block system for passenger trains, but the permissive block was used for freight trains, and they relied entirely upon the intelligence and watchfulness of the block signalmen, not upon mechanism, as in the track circuit electric block system, or in the admirable Sykes system, which is a combination of human and mechanical protection. Without the latter, breakdowns of the block system sometimes occur from human forgetfulness, as in the Meadows disaster just out of Jersey City some years ago, where three trains were wrecked.

After 21 months of experience with the part of the system first installed on the P. & W. R. R., and 137 days' experience with the complete plant for the entire road, Mr. Chamberlain made a report to the Railroad Commissioner of Rhode Island, giving in much detail the results of his experience with the plant, of which he spoke in the very highest terms. We reprint below the whole of this report, omitting the formal introduction and the detail tables, which latter are quite extensive. The report in full will be found in the report of the commissioner for 1884. It bears date Jan. 11, 1884. Its publication at this time seems especially pertinent in view of the present interest in the question of block signaling caused by the recent severe accident on the New York Central & Hudson River R. R. due to the lack of such signals; and it is of interest as showing to what perfection the system of automatic block signaling had been brought nearly ten years ago.

When I made the contract with Mr. Henry Snyder, agent of the Union Switch & Signal Co., of Pittsburg, Pa., I informed him at that time that, if he could make the signals work successfully on this 1st division, he need have no apprehensions of its satisfactory operation on any other road in the country. The roadbed at that time was of a very sandy nature, requiring a great deal of time and labor, from the nature of its condition, to keep it in first-class working order. I informed you in my letter of Dec. 30, 1881:—

1. (See p. 52 of Commissioner's Report of 1882) That no other system can operate a signal through a long section of rails, consequently:—

2. There is no other which will show the presence of a portion of the train on the signal section when a part of the train, having broken loose, has passed beyond the section.

3. It is the only system which will show the danger signal when a train has entered within the block section from a side track, or from the opposite end from that usually entered upon.

4. It is the only system in which a broken or torn up rail will show the danger signal.

5. Any tampering with or derangement of the mechanism or battery in the block system will show the danger signal, so that any error from any cause will be in favor of safety. It is impossible to show "safety" when the danger exists which the signal is designed to avert.

6. It is the only system in which obstructions, caused by placing rails across the track, will show the danger signal.

These assertions I am now prepared to confirm by totals shown in the 21 months' report sent to you herewith.

I informed you that it afforded a more perfect protection than is possible with the English block system, controlled from stations, or any other system. It is evident that railroad companies in protecting their trains must have a system whereby the signal to any section is controlled by the train or any part of the train during the entire time of its being in that section. This system we have in practical operation.

I also stated that we had contracted for about ten miles of these signals in Massachusetts, on what is known as the 2d division; that we had guarded all the railroad crossings at grade, from Worcester, Mass., to Hamlet, R. I., with bells 12 ins. in diameter, set on both sides of the track to protect the traveling public when trains are nearing the crossings from either direction. These bells commence ringing when trains in either direction or both directions are within 1,500 ft. of the crossings, and continue to ring until trains have passed the same.

I am happy to inform you that the Providence & Worcester Railroad Co. has now equipped its 2d division from Boston Switch to Worcester with a complete system of these signals, [completing the equipment between Providence and Worcester].

I herewith send you a detail report of working of the signals on the 1st division, from April 1, 1882, to Dec. 31, 1883, inclusive (21 mos.). In regard to the working of signals on our 2d division:—there are 48 regular block signals; all switches are connected in the blocks. I herewith send you a report of their operation for 37 days, from Nov. 19 to Dec. 31, 1883, showing totals; also present a statement of grand totals for the entire length of road from Providence, R. I., to Worcester, Mass., (44 miles) The reports show for themselves that my expectations have been more than realized in regard to the results obtained.

You are aware the Providence & Worcester Railroad is the only railroad in the country thoroughly equipped with the Automatic Electric Block system of signals. No new device of any nature was ever known to be perfect when first introduced. Many of the failures were caused by some of the parts not being properly proportioned, and required experimental tests to make them perfect. We find from the monthly reports of the signals that failures caused by the mechanism are gradually disappearing, and we expect to be able within a short time to have the system so perfect that a failure will be a rare occurrence.

But, more fully to illustrate it; our report shows that in the first 3 mos. in operating the signals, the percentage of failures to number of operations was 0.096 %, while in the last 3 mos. ending Dec. 31, 1883, there is only a showing of 0.016 % of failures. You will bear in mind that in all the failures the signals have shown danger, and have fully performed the duty for which they were erected.

Our instructions to engineers and other employees are as follows:—

"The Block Signals are constructed so that they will show danger under the following conditions, viz:—

If a block ahead is occupied by a train, engine, car of detached train, or a hand car; a switch misplaced, a car standing on side track so as to obstruct the main track, a broken rail, or battery out of order.

On each side track there has been placed a post marked S. Nothing must be left standing on any side track between that post and the switch on main track, because that will show an obstruction of the main track. Your attention is called to this important order.

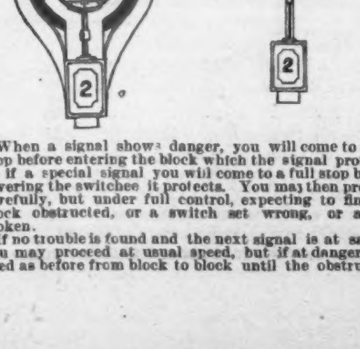
Engineers, conductors and trainmen will be governed by these Electric Block and Special Signals, as per following instructions:—

Block and Switch signals bearing odd numbers are for the government of Outward trains; even numbers governing Inward trains.

Special Signals, governing switches only, are lettered and may have special colors for danger or safety.

The Safety Signal is a round white target by day and a green light by night, thus:

The Danger Signal is a flat red target by day and a red light by night, thus:



When a signal shows danger, you will come to a full stop before entering the block which the signal protects, or if a special signal you will come to a full stop before covering the switches it protects. You may then proceed carefully, but under full control, expecting to find the block obstructed, or a switch set wrong, or a rail broken.

If no trouble is found and the next signal is at safety, you may proceed at usual speed, but if at danger, proceed as before from block to block until the obstruction is passed. Report all stops or detentions on blanks furnished for that purpose. Study carefully the description of Blocks and Special Signals.

Road masters and section foremen will thoroughly post themselves in regard to the working of the Electric signals, and teach their men to keep the track wires and insulations in perfect order, bearing in mind that on you, in a measure, depends the proper working of the signals. No rail or frog must be changed (except in case of emergency) unless the foreman in charge of signals is on hand to make the proper connections.

Bells have been placed at each road crossing to warn gatemen of approaching trains; when either bell rings the gateman will immediately close the gates and keep them closed until the train has passed, except at points where switching is being done within the bell circuit.

The cost of maintenance per mile I am not prepared to give as yet on account of improvements made from time to time. Hoping that my explanations have been satisfactory, I am, yours respectfully,

W. E. Chamberlain, Supt.

This letter was followed by elaborate tables, which we omit. The summaries of the main results from the operation of the signals we condense as follows:

	2d Div., 39 miles.	1st Div., 5 miles.
Period covered by report	37 days	21 mos
No. of passenger trains run	1,295	46,142
No. of freight and engine trains run	760	21,121
Total No. of trains run	2,055	67,263
Average per day each way	28	54
No. of trains stopped for—		
Good cause (train or switching on section ahead)	128	2,826
Carelessness of employees	4	141
Failure of circuit or signals	18	285
Total No. of signals operated	48	28
Total No. of operations	49,320	941,068
Total No. of failures	12	285
P. c. failures to total No. of operations	.024	.0303
Of these failures there were due to the carelessness of employees.	4	96
P. c. of careless failures to total No. of operations	.008	.0102
Lights out	13	85

Twelve broken rails stopped 36 trains.

Among the instances in which trains were stopped for good cause were:

12 cases of broken rails,

193 cases of open switches,

7 cases of hand car on track,

1 case of cars on side track too near main track,

56 cases of switching in progress, and

2,685 cases where a train was occupying the section ahead.

The last of these cases only are provided for under the original form of the block system, in which human intelligence only is relied on to work the signals, and protection against other trains only is provided; but when all switches are also interlocked, as they all but universally are in England, 256 other cases of the above list drop out, and there remain only the 20 cases of broken rails, hand cars on track, and partially obstructed switch leads, as evidences of the peculiar advantages of this automatic block signal plant. Still, though these instances are comparatively few, each of them might have caused an accident, and there were a good many of these, absolutely, considering the short distances and the brief period of time covered by the report.

The greatest objection made to this system, however, is that every break-down of the apparatus causes delay, though it can in no case cause danger, by showing danger when no danger really exists. It will be seen above that in just 297 cases, or an average of once very 2¼ days, there was some such failure of some one of the 103 signals, delaying about twice as many trains more or less, without good cause other than such break-down; but the report also shows that in the first 3 mos. after the plant was installed there were just six times as many of these failures as in the last 3 mos. covered by the report; and as there were over ten times as many cases of trains stopped for the very good reason that there was a train on the block ahead of them which (usually) did not belong there, and as the failures were only about one out of 4,000 operations of each signal, the evil could be borne a good deal better than Hastings disasters, it seems to us. Moreover, since that date there have been considerable improvements in this and other kinds of block signal plant. The recent experience of the P. & W. R. R. with these signals will appear from a letter from the Chief Engineer of the road in our last issue. It will be seen to be entirely satisfactory, though very naturally the careful tabulations of the results which were made when the plant was put in have not been continued.

It may be noted that the most frequent cause of failure by far was breakage of the track wires by which the rail circuit was maintained through the joints. The next most frequent trouble was carelessness of the employees in caring for the batteries and mechanism in general.

In view of the above record, which in its main facts has been sufficiently notorious among those who keep informed as to railway affairs of this kind, an extract from a "railroad" paper of this city, which appears on our editorial page, denying that the Providence & Worcester has ever had, or even has now, any block system in use, is a trifle surprising.

The cost of maintaining these signals, and the present practice of the road in regard to them are shown in a letter from Mr. E. P. Dawley, Chief Engineer N. Y., P. & B. R. R., dated Jan. 11, 1892, from which we make the following extracts. The first cost was stated at about $500 per signal in a letter from the same officer published last week, in which also were given some further details about the operation of the plant.

I have had the following information regarding cost of maintenance pretty carefully looked up, and find that on our Main Line Division for the year ending June 30, 1890, it cost us for maintenance of 40 electric block signals very close to $120 each; and for the fiscal year ending June 30, 1891, that maintenance, labor and material, of 58 signals cost us $6,064.17, or about $104 each, which figure is probably more accurate than the statement for the previous year. It would, however, probably be more nearly accurate if $25 or $30 a year was added to cover wear and tear on the signal, which in not included in figures above stated, or say $130 per year per signal.

I note your publication of my letter of Dec. 30, 1 91, to which I had no objections, also a statement in the "Railroad Gazette" bearing on the matter of signals on the Providence and Worcester Railroad. It is true that the Worcester Division is not continuously blocked, as one might infer from my letter of Dec. 30 (wherein it was only claimed, however, that about 42% of our main track mileage was protected by block signals); but in further explanation of the facts regarding Worcester Division between Valley Falls and Worcester I will say that that portion of the road has automatic *block* signals at all stations and in some places (considered more especially dangerous) between stations; furthermore in several instances the stations are so near together that these station signals become in effect *continuous* blocks.

The italics in this extract are the writer's.

MILD STEELS FOR STRUCTURAL PURPOSES.
II.—BASIC STEELS IN GERMANY.

By Gus. C. Henning, M. E.

[Concluded from page 44.]

The limits of 52,000 to 62,000 lbs. per sq. in. in tenacity may seem very wide to assure uniformity throughout a structure, and it may be asked whether it is not advisable to narrow these limits. It must not be forgotten that rolling produces differences in qualities according to variation in shape; if the upper limit were reduced, large quantities of material otherwise satisfactory might be rejected, increasing the difficulties of the manufacturers and metallurgists, and causing considerable delay without materially improving the quality of a structure. Actually these differences in quality are not as great as would appear from a comparison of tenacities alone.

In judging of quality, the absolute resistance of material is not as essential as its resilience, which is nearly proportional to the product of tenacity and elongation; and as stronger varieties always show less elongation, the product remains nearly constant. To obtain uniform material and emphasize its importance, the specifications should contain a minimum value allowable for relative resilience. A reasonable requirement, which does not cause acceptance of a great quantity of unsatisfactory material, is that this product of tenacity, in kilograms per square millimeter, by elongation, measured on 200 mm., should be not less than 800. With this value the elongation varies between 21.70% and 18.2%.

The other conditions which should be prescribed for the material include a minimum figure for elastic limit, which is as essential as relative resilience. The minimum elastic limit to be called for by specification should be about 34,000 lbs. per sq. in., which is easily obtainable.

Amount of contraction at point of rupture is without theoretical value but gives practical indications of quality of steels; for an abnormally low result is very suspicious and a minimum figure should be stated. According to past experience, "natural" basic soft steel of normal properties gives not less than 40% contraction, and this might be adopted as a practical value.

It does not seem advisable to call for a given chemical composition, as physical tests and properties determined thereby would be sufficient for the engineer. A too great percentage of phosphorus can always be readily and certainly detected by proper bending tests.

Another matter to be determined is how to test to determine whether the material as used fills the specifications in every respect. It is a question whether material should be tested in the shape of rods rolled from test ingots; whether pieces should be cut from finished shapes, or whether double tests should be made in both these ways. This latter seems like a very complicated, expensive and dilatory method and must cause trouble in many ways. On the other hand it does not seem to concern the engineer what qualities the material may have in the form of small round rods or in ingots, as he uses the metal only after rolling.

It is, however, necessary for the steel works to examine its own product in the shape of ingots to judge whether the material will fill requirements after rolling. Hence these tests need not be made by the engineer. It is his duty to test the material after rolling, as improper heating, burning or rolling may entirely change or injure a material otherwise good. It is true that in the United States it has been a frequent practice to accept material upon "billet tests," but frequently with decidedly unsatisfactory results. Fortunately this method is being replaced by the more satisfactory one of testing rolled material only, after having examined the steel works' report of billet tests, which are made as regularly as the chemical analyses, fracture tests, etc. All material is of course stamped with heat numbers for future identification.

One of the leading American railways, in fact, calls for tests from each heat in every furnace in which the steel is reheated before rolling. If, therefore, the mill superintendent is careful to charge only blooms from one heat or melt in one furnace, this materially simplifies the testing, expedites work to its utmost limit and insures possession of a correct knowledge of the rolled material. In Germany material is invariably tested after rolling, as the necessity of doing it was established long ago and a better method has never been proposed.

The following series of tests was made to prove its necessity on three heats of basic open-hearth steel, numbered at the steel works as 1,537, 1,538 and 1,539:

A test ingot from each heat was poured when the ladle was half emptied, and was rolled into rods of 1.02 in. diam., from which test pieces 0.79-in. diam. were turned. From the same heats were rolled bars 4 × 0.39 in., angles 4 × 4 × 0.39 in., and plates 0.39 in. thick.

To test at the same time the effect of different treatment in the furnace, specimens of each section were rolled under three conditions: (1) at normal heat, (2) after burning, and (3) rolled cold.

Of the tension tests on material rolled at a normal heat (recorded in Table IX.) those on the rods rolled from test ingots gave best results. The smaller percentage of elongation in shapes is not able. The last column of Table IX. shows the percentage of loss in relative resilience of the different sections as compared with that of the test billet, or rod rolled from test ingot.

Table IX.—Comparative Tests of Steel Shapes and Round Rods Rolled from Test Ingots; All Rolled at Normal Heat:

Shape.	Heat No.	Elastic limit. Lbs. per sq. in.	Tenacity. Lbs. per sq. in.	Contraction. %	Elongation. %	Relative resilience.	Loss in rel. resil. %
Bars	1,537	41,370	57,610	52.2	26.7	1,078	— 2.3
	1,538	38,550	57,400	53.2	24.5	900	—13.9
	1,539	42,750	59,960	51.6	26.6	1,121	—11.9
Angles	1,537	35,130	54,550	....	26.6	1,120	— 7.5
	1,538	35,770	54,850	50 5	27.5	1,000	— 7.7
	1,539	38,760	58,300	53.8	24.2	995	—11.9
Plates	1,537	39,830	54,120	56.8	21.2	868	—26.7
	1,538	41,750	56,970	....	20 2	811	—29.4
	1,539	43,240	59,320	....	21 7	967	—28.8
Test Billet	1,537	38,120	57,610	52.4	27.2	1,103	....
	1,538	37,200	56,180	49.0	25.1	1,149	....
	1,539	40,900	59,320	61.1	30.3	1,273	....

Material rolled from burned blooms invariably showed torn surfaces. Small irregular lateral fissures or cracks were to be found almost everywhere upon close inspection. The edges showed more serious defects, which appeared as though rolling had torn the material. Plates alone did not show these defects everywhere, and they had large spots which were quite perfect. In Table X. are given results of tests of burned material. The test specimens in the case of heat No. 1,538, were purposely taken from parts which did not show these defects, while those from 1,537 and 1,539 were cut from defective places.

Table X.—Tests of Various Sections Rolled from Burned Blooms.

Shape.	Heat No.	Elast. limit. Lbs. per sq. in.	Tenacity.	Contraction. %	Elongation. %	Rel. resil.	Loss in rel. resil. %
Bars	1,537	34,850	55,050	39.6	16 5	638	—42.0
	1,539	38,550	58,320	36.8	21.0	861	—32.3
	1,538	33,780	54,270	37.6	16.7	639	—41.3
Angles	1,537	34,850	53,770	58.5	24.0	907	—17.7
	1,539	37,050	53,700	37.1	17.2	649	—49.0
	1,538	35,980	53,910	42 0	16.5	646	—43.8
Plates	1,537	40,330	58,320	53.1	17.2	707	—35.9
	1,539	42,670	60,950	52.6	19.5	836	—34.3
	1,538	41,390	57,900	57.6	21.2	865	—24.3

It is evident that the material was uniformly injured. Surface inspection and physical tests were found to agree very closely. Of the bars, heat 1539 showed least surface defects and was considered least burned, and the tests showed that the relative resilience was decreased but 32%, while in the case of the others this was 42% and 44%; the same coincidence was also found in the case of the plates.

In the case of test pieces cut from the sound part of plate of heat No. 1538, results were obtained even better than those from the plates rolled at normal heat, while the tests cut from defective parts showed decided inferiority. It therefore appears that the injury due to overheating is caused principally by the mechanical effect of rolling, and it is most noticeable in the case of the sections which do not stretch uniformly over the entire cross section during rolling, causing tearing of the material. The injury is therefore most noticeable in channels and beams and least in plates. Surface inspection and tension tests verify this conclusion.

Bending tests are most certain to detect burned material, and in the case of the nicked bending tests the material bends but little, and breaks suddenly with the well known coarsely granular structure due to burning.

The tests which were made to determine the effect of cold rolling were limited by the strength of the rolls, for to avoid the possibility of breaking a roll the material had to be rolled at a considerable heat.

For this reason plates ⅜ in. thick could not be rolled at less heat than a cherry red.

Table XI.—Tests of Materials Rolled at the Lowest Heat Possible.

Shape.	Heat No.	Elast. limit. Lbs. per sq. in.	Tenacity.	Contraction. %	Elongation. %	Rel. resil.	Loss in rel. resil. %
Bars	1537	41,750	58,600	60.6	29.2	1205	+ 9.2
	1538	37,840	50,600	52.9	25.8	1063	— 5.7
	1539	45,450	61,450	54.0	26.2	1128	—11.4
Angles	1537	38,550	54,900	65.0	28.2	1013	— 8.2
	1538	37,340	53,070	65.8	28.3	981	—14.6
	1539	38,120	54,840	64.4	26.9	1027	—18.5

From this it will be seen that rolling at a cherry red produced in every case somewhat better results than were obtained from the same materials rolled at usual temperature. Although these few tests do not conclusively show that it is beneficial to roll as cold as possible, yet they go to prove that injury is not likely to be caused by cold rolling. But a possibility of injuring weak materials nevertheless exists, as tests with a sheet ⅛ in. thick showed. In this case rolling at ordinary temperature produced a material having 59,720 lbs. per sq. in. tenacity and 20% elongation; while the same plate rolled at a dark red had a tenacity of 76,788 lbs. per sq. in. and an elongation of only 13%, or a loss in relative resilience of 840 — 702 = 138, or 16.4%. All cold rolled bars showed a red-brown surface, while those rolled at usual temperature were bluish gray.

The foregoing tests may be taken as proving that rolling may injure material, and hence tests should be made on finished shapes. This would necessitate testing all material twice, once in billets of each heat, and again after rolling. Considerable trouble, delay and expense would be caused by such procedure; and as the engineer must know the qualities of finished material, while the mill manager should know the qualities of the material which will work up so as to have the qualities called for by the engineer, it seems the proper thing to let the former

use his own methods to judge of the qualities of material in its early stages, and for the latter to test only finished material. To protect himself and work up only such material as will give the desired results, the mill manager will carefully grade and mark all of his product, and this will simplify the work of the engineer, who has then only to test the finished shapes out of each charge or heat. The fewer heats or charges used in any order, the less will be the number of tests necessary and the less the unavoidable delay caused by testing. Before proceeding to make tests, however, it will be of the first importance to examine the rolled material for surface defects, and reject all that shows checks, cracks at corners, or slivers, as all of these are invariably proofs positive of defective or injured material.

Tension tests follow surface inspection, and results obtained must lie between 52,600 and 62,600 tenacity, elastic limit not less than 34,100, contraction of area at least 40%, and relative resilience at least 800.

Cold bending tests should invariably be made, if only to detect too high a percentage of phosphorus in the absence of chemical analyses. It may be prescribed that a strip 2 ins. wide, with edges slightly filed, shall bend 180° around a diameter equal to one-half the thickness of the test piece without showing signs of failure. Closing down the test piece upon itself generally produces cracks on the inner surface at the bend, which, especially in the hands of a careless workman, will cause failure and hence should not be called for.

All of these experiments, then, show that the acceptance of steel is dependent upon the same methods of examination which have heretofore been used with wrought iron; and there is no plausible reason why fewer or less critical tests should be applied in the case of steel than were customary in the case of wrought iron.

As the failure of any bridge, assuming it to have been properly designed, is dependent upon accidental causes, such as shock due to derailment of a train or the like, it follows that the properties which are of greatest importance in such case are not at all ultimate resistances or elasticity, but resilience. In such case it does not matter whether the elastic limit has been passed, but it is merely sufficient that the structure does not fail.

If a diagram be constructed, of which the ordinates are the resistances and the abscissas the elongation under such resistances, then the area of this diagram will represent the work which the particular material is capable of doing or its capacity to resist impact or shock. In Germany, specifications for wrought-iron prescribe a tenacity of 51,200 lbs. per sq. in., with an extension in 8 in. of 12%, or a relative resilience of

$$\frac{51,200}{1,422} \times 12 = 432.$$

In the case of low steels it was seen that relative resilience might be set at not less than 800. Thus the same safety in structures would be secured if the allowable working loads were assumed 85% greater than those heretofore allowed in structures of wrought-iron.

Another consideration as to the safety of structures is their elastic resistance under permanent or steady loads. The elastic limit is the quantity which determines this; and comparing wrought iron with steel, we find that they compare as 22,700 to 34,000, or that steel can be safely strained over 51% higher than wrought-iron. As this figure is smaller than the previous one, it would be the one to be adopted.

However, as the experience with low steels in Germany is still so limited, Prof. Krohn would still further lower this allowance, and he recommends that the increase in the unit strain where low steel is substituted for wrought iron be set at 25%.

THE VARIOUS STATISTICAL SUBDIVISIONS OF THE UNITED STATES.

The accompanying map shows the new grouping of the states adopted by the Interstate Commerce Commission, as also two similar groupings (similar in intent and substance, but unfortunately differing in detail) adopted by the U. S. Census and (years ago) by Poor's "Railroad Manual" and our own "Manual of American Water Works." It is a public misfortune that these three groupings should be so radically different as they are. The serious objections to this confusion of groupings do not seem to be adequately appreciated by the public officials who are responsible for it. The groupings adopted by Poor's "Railroad Manual" and the "Manual of American Water Works," being of many years standing, and having had very valuable, if unofficial, statistics based upon them for many years, had a strong presumption in their favor, which neither the U. S. Census nor the Interstate Commerce Commission has seen fit to respect; but they should at least have adopted a common new grouping which, had they agreed upon it, would naturally have become standard.

The Subdivisions of the United States Used for Statistical Purposes by (1) The Interstate Commerce Commission; (2) The United States Census, and (3) Poor's Railroad Manual and the Manual of American Water-Works.

Boundaries of Interstate Commerce groups shown by solid black lines, with numbers for each group.
Boundaries of United States Census grouping shown by dotted lines .....
Boundaries of Railway and Water-Works Manual groupings shown by broken lines - - - - -

The original or unofficial grouping made eight subdivisions of the territory, the groups being such that they could readily be given distinctive names.

These groups were: New England, Middle, South Atlantic, South Central, Southwestern, North Central, Northwestern and Pacific. Their boundaries followed certain natural lines of demarkation, both physical and sociological, and thus readily permited of combination into a variety of grander subdivisions of the entire territory, as between the north and south, east and west, north, south and Pacific, etc., etc.

The U. S. Census has, without a shadow of good reason which we can discover, cut down the number of these subdivisions to five, entitled respectively, North Atlantic, South Atlantic, North Central, South Central and Western. The Interstate Commerce Commission has now made confusion more confounded by as arbitrarily subdividing the territory into ten groups, to which it is impossible to assign concise geographical names, and in which state lines are but little respected. The motive may easily be inferred from the form of the groups. They chance at the moment to conform a little better to the present subdivisions of the railway system, and so somewhat simplify the work of the government clerks, who are apt to look upon anything which does that as highly important. But this is a condition which changes constantly, and if the statistician of the commission proposes to pay no more respect to his own than to others' prior work (and why should he?) we shall for the same reason be treated hereafter to an indefinite series of such variations, as the railway mileage of the country is combined and recombined, for each of which changes there will be quite as good reason as there is for those which have already so unfortunately occurred.

By referring to the map it will be seen how radically the groups differ. It would be quite impossible to clearly describe the divergencies in words, as they even extend so far that there is only one group out of them all (New England) which is the same in any two of the three groupings, and that differs in the third one. Nor can any two or more groups of any set be so added together as to make one or more of any other set, unless we add the whole United States together, with the sole exception that the New England and Middle groups of the unofficial grouping make the North Atlantic group of the census.

The public officials, each with his mind fixed upon his own work only, and each, perhaps, feeling the true official contempt for prior unofficial work, do not seem to have appreciated that for very many purposes it is desirable that complete statistics of many different kinds for each group should be compared or comparable, in order to extract the true meaning of any statistics. One's sense of the evil done, and of the unreasonableness of it, is not decreased when it appears from examination, as it soon will, that the first grouping established, that of the unofficial "Poor's Manual" is, on the whole, the best one of the three for general use. When the U. S. census discarded it we were disposed to accept its action without grumbling, supposing, of course, that it would be made the basis of all the government statistics. But to find out, as we now do, that each government bureau is to be allowed to be a law unto itself in this matter, regardless of either official or unofficial precedents, is a little too much. We can do nothing but protest; but we do protest.

A bill for fortifications and coast defense to the extent of $100,000,000 has been favorably reported to the U. S. Senate from the Committee of Coast Defenses and Fortifications. It provides for fortifications as recommended by the Fortifications Board appointed by the President. The cities selected include about all those of any importance on the Atlantic and Pacific coast lines. The bill would expend from $10,000,000 to $20,000,000 in the first year, and about $9,000,000 annually for 10 years thereafter.

The Beach Pneumatic Conveyor Co., of Chicago, has taken patent on a system for carrying the mails and small parcels by means of an air blast through pneumatic tubes. The idea is to do away with the use of a cartridge in which the message is usually placed and practically float the letter or parcel on a current of air to its destination. This current is to be furnished by a system of blast engines putting air into the tube and exhausting it at the other end. In extremely long lines relay blasts and exhausts will be established for the purpose of keeping up the velocity and carrying capacity of the air current. It is claimed that by this system letters and packages can be quickly and easily conveyed from the depot to the main office. The company was incorporated in January, 1892, under the laws of the state of Illinois, Mr. Geo. W. Straight being President, and holding a franchise in a portion of the southwestern part of Chicago. It proposes to apply for franchises in the business portion of the city, and operate the system as circumstances demand.

ELEVATED RAILWAY; CHICAGO & SOUTH SIDE RAPID TRANSIT CO., CHICAGO, ILL.

[With inset.]

We present in this issue the drawings of an elevated railway now under construction at Chicago, Ill., a considerable section of which is already completed, and is expected to be in operation by April. The Chicago & South Side Rapid Transit Co. has from the outset adopted a policy in regard to the construction of its road which will keep it free from future suits for damages to property. The line is popularly known as the "Alley road" from the fact of its route following along the alleys which bisect

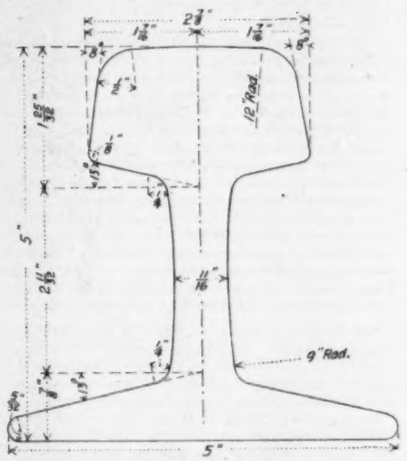


Fig. 4. Cross Section of 90-lb. Rail for Chicago & South Side Elevated Railway.

the street blocks, but the structure is not built over the alleys. The company has acquired a right of way about 30 ft. wide along one side of the alley by purchase or condemnation proceedings, and this has been very slow and tedious work, as owing to the activity in real estate business in Chicago, and the frequent transfers of property, it takes a long time to obtain a clear title to each individual piece of property. All this work is done by a title guarantee company. Under condemnation proceedings, plans are submitted to the court for each piece of property, showing the location of the railway structure, the clearance of cars, etc., and the jury awards the price after consideration of three points, viz.: First, the value of the property; Second, the allowance to be made for improvements; Third, the allowance to be made for damages due to the operation of the line. These proceedings give the company a clear and undisputed title to its right of way, without fear of claims for damages in future.

The route of the line is along the alley which runs north and south through the blocks between Wabash Ave. and State St., as shown on the map (Fig. 1) accompanying the article on the World's Columbian Exposition in another column. Work was commenced in February, 1890, and the road is now practically completed from 12th St. to 39th St., with the exception of one or two short gaps over disputed property, and the work of erection is now in progress northward to Congress St. The northern terminus is intended to be ultimately at Madison St. South of 39th St. the right of way has been acquired to 63d St., where the line will turn east and be built along that street to Jackson Park, having a terminus inside the grounds of the exposition, as shown upon the map, Fig. 2, in the article above referred to. An extension south toward Englewood is projected. By the recent sale of bonds to Marshall Field, P. D. Armour and other local capitalists, the company will be enabled to complete its line from Congress St. to 39th St., a distance of about 4 miles, and have it in operation by April, while the entire length to Jackson Park is expected to be completed by 1893. Contracts have been given out for the equipment of the first section of the road.

The railway is a double track deck structure consisting of four lines of main longitudinal plate girders, connected by angle iron bracing, and carried upon a double row of columns. The general form of construction is shown in Figs. 1 and 2. Iron is the material for the superstructure, and the Keystone Bridge Co. has the construction contract. The foundations are about 10 ft. deep below the surface and rest upon hard clay, the pressure on which will not exceed 1,800 to 2,000 lbs. per sq. ft. On this clay is laid a bed of concrete 12 ins. thick and 7 ft. square for each foundation, and on this concrete is masonry, 6 ft. square and about 2 ft. 4 ins. thick. Two stone blocks 5 ft. 6 ins. × 2 ft. 6 ins. and 6 ins. thick hold the heads of the anchor bolts. Above these stones is brick masonry 4 ft. high, 5 ft. square at the base and 4 ft. square at the top. This is capped by a bluestone block 3 ft. 6 ins. square and 1 ft. thick, upon which rests the cast iron base for the column. This base weighs 1,800 lbs., and is held down by four anchor bolts, 1¼ ins. diameter and 6 ft. long. It has sockets 21½ ins. deep for the two channels of which the column is composed, and when the column is in place the space around it is filled with a mixture of iron filings and sal ammoniac.

The columns are each 15 × 15 ins. square, composed of two 15-in. channels weighing 150 lbs. per yd., with a latticed bracing of bars 4 × ¼ ins., riveted inside the flanges of the channels by ⅝-in. rivets At a height of 11 ft. 6 ins. from the ground the channel irons are curved outward to a radius of 5 ft., so as to be wide enough at the top, 16 ft. above the ground, to carry the two longitudinal girders. At the top the channels are connected by two angle irons, 6 × 6 × $\frac{7}{16}$ ins., and plates $\frac{7}{16}$ in. thick. The girders rest upon bearing plates ⅝-in. thick. The transverse distance between the columns is 12 ft. c. to c., except at stations, where it is 19 ft. 9 ins. to allow the longitudinals to rest on brackets riveted near the bottom of the web of transverse girders, and make room for the station buildings, as shown on the plan, Fig. 5. The longitudinal distance is from 35 to 60 ft. c. to c.

The longitudinal girders of each track are placed 5 ft. apart c to c., and the space between the inner ones is 7 ft. c. to c. These girders are 35 to 60 ft. long. The shorter ones are 42 ins. deep and weigh 7,000 lbs.; the 50-ft. girders are 48 ins. deep, and the 60-ft. girders are 54 ins. deep and weigh about 9,000 lbs. The top and bottom chords are 12⅝ ins. wide, each composed of two angle irons, 6 × 4 × $\frac{7}{16}$ ins., secured to the web plate by ⅞-in. rivets, with a pitch of 4 to 6 ins. The web is ⅝-in. thick, and has vertical stiffeners of angle iron 4 × 4 × ⅜ ins. at intervals of about 5 ft., with filler plates 40 × 4 × $\frac{7}{16}$ ins. The filler plate, or splice plate, at the middle of the girder is 40 × 16 × $\frac{7}{16}$ ins. At their ends all the girders are connected by angle irons 2½ × 3 ins., weighing 21 lbs. per ft., with vertical diagonal cross bracing of the same size angle irons. The two girders of each track are also connected by a single horizontal diagonal bracing riveted to the top chords, and a similar bracing riveted to the bottom chords, as shown by the plan, Fig. 1. This bracing is of angle irons, 3 × 3½ ins., weighing 21 lbs. per ft., and fastened with ⅞-in. rivets. The girders are secured to the tops of the columns by ⅞-in. bolts and rivets, and slotted holes to every other span are provided to allow for contraction and expansion. The structure is painted a light yellow.

The material for the girders has an ultimate strength of 50,000 lbs. per sq. in., and it is estimated that the flanges will not be strained more than 10,000 lbs. per sq. in. by the equipment to be used. The rolling load is taken at about 1,000 lbs. and the dead load 270 lbs. per lin. ft. per girder. Details of the wheel spacing, wheel loads and strains, with composition of girders of different spans, etc., are given in the inset sheet. The train load diagram shows a tank engine with 16,000 lbs. on each driving axle, with a driving wheel base of 5 ft., and 12,000 lbs. on the truck; followed by cars with a weight of 16,000 lbs. on each truck. The structure was designed for locomotives weighing 45 tons, but the engines now under contract will weigh only 28 tons.

The minimum clear headway is 16 ft. to the bottom of the girders, but at 16th St. this is increased to 20 ft. Beyond this the headway is increased by a grade of 20 ft. to the mile to cross the viaduct carrying 12th St., over the surface tracks of the A., T. & S. F. Ry., and the lines running to the Dearborn St. station. The line is straight and practically level.

The extension eastward to Jackson Park will be built over the roadway of 63d St., and will be of a different design, as shown by Fig. 3. It will be for the most part a three-track structure with longitudinal plate girders carried on brackets riveted to the bottom chords of the trussed transverse girders. The transverse distance between the columns will be 22 ft. c. to c., and the distance between the tracks, 12 ft. c. to c. The headway will be 14 ft., and the height from the curb line to the rail level, 20 ft. 2 ins. The width of the street between building lines is 66 ft.

The track will consist of steel rails weighing 90 lbs.

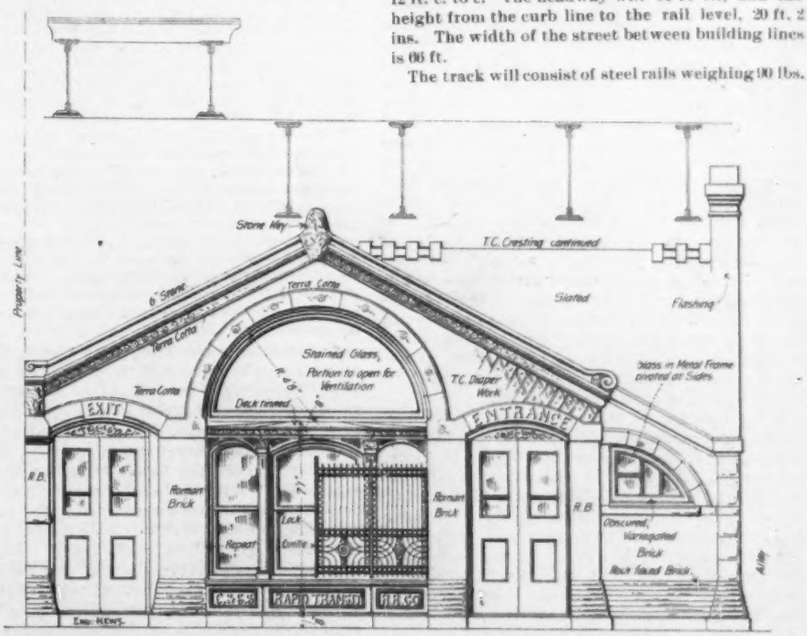


FIG. 6. FRONT ELEVATION OF TWENTY-SIXTH ST. STATION; CHICAGO & SOUTH SIDE ELEVATED RY.

per yard, secured by spikes 5½ × $\frac{7}{8}$ ins. to hardwood ties 8 ft. × 6 ins. × 8 ins., spaced 20 ins. c. to c. The ties will be fastened to the girders by hook bolts. There will be two timber guard rails 6 ins. wide and 8 ins. high to each track rail, the inner ones being about 4¼ ins. from the track rail, and the outer ones on the ends of the ties. Between the tracks are cross timbers 6 ins. square, upon which are laid four lines of plank 6 ins. wide and 2 ins. thick, forming a walk for the trackmen and employees. The Servis tie plate will be used to some extent (Eng. News, April 4, 1891). The Fisher bridge joint will in general be used for the rail joints, but in places where the construction will not admit of them there will be

three-tie joints spliced by 30-in. angle bars and six bolts. The rails were rolled by the Illinois Steel Co., and are of the section shown in Fig. 4, being the same as that adopted for the Manhattan Elevated Railway of New York. The dimensions are as follows:

	Inches.
Height	5
Width of base	5
Width of head at bottom	2⅛
Angle of side of head	8°
Depth of head	1⅛
Height of web	2⅛
Depth of flange	5/16
Thickness of web	½
Radius of top of head	12
" top corners of head	1/16
" bottom corners of head	1/16
" top and bottom fillets	¼
" top and bottom corners of base	1/32
" side of web	9
Fishing angles of head and base	13°

The arrangement of the stations is very different from that heretofore adopted for elevated railways, the station buildings of this road being placed on the street level, underneath the structure, one ticket office being thus sufficient for both lines of traffic. The plan of the 26th St. station is shown in Fig. 5, and the elevation and its relation to the main girders are shown in Fig. 6. The inner platform is close to the property line, while the outer one overhangs the alley. The building are of brick and terra cotta, with slate roofs, and have a pleasing effect. Our illustrations represent the 26th St. station. The building is 41 ft. 6½ ins. long on the alley, and 30 ft. wide, fronting on 26th St. The ticket office is in the middle of the street front and has a bow window. The entrance is on one side of this, and opens into a waiting room 17 ft. 10½ ins. by 16 ft. 8¾ ins., with seats along one side. Toilet rooms with tile floors are provided for men and women, and there is a large news stand. Opposite the ticket office is the entrance to the stairs leading to the platforms, which are 24 ft. above the street level. The exit stairways are also at the rear of the building, leading to an exit corridor 4 ft. 8 ins. wide running along one side and opening into 26th St. Across the stairways, in order to provide headroom, the tracks are carried by 15-in. I beams, about 15 ft. long, as shown in the rear and side elevations, Figs. 7 and 8. The platforms are 200 ft. long, sufficient to accommodate a train of six cars. They are 8 ft. wide and 3 ft. 3 ins. high from the top of the cross girder, and each is protected by a roof supported on two rows of columns. The total width over platforms is 37 ft. 2 ins., and the height from street level to ridge of roof is 36 ft. 6 ins. Transverse plate girders are used at the stations, the longitudinal girders being carried on brackets riveted near the bottom of the web, as already explained, and the platform girders are supported upon cantilever brackets forming extensions of these transverse girders. It is intended to have electric gongs and indicators in the waiting rooms to announce the approach and direction of trains when within 500 ft. of the station. The stations and platforms will be lighted by gas or electric lights.

A contract for 20 tank locomotives with rear tank bunker carried on a four-wheel truck, has been given to the Baldwin Locomotive Works, of Philadelphia, Pa. They are to be four-cylinder compound engines, on the Vauclain system, with four driving wheels 42 ins. diameter, driving wheel base of 5 ft., and total wheel base of 16 ft. They will weigh 56,000 lbs., with about 40,000 lbs. on the driving wheels. The boilers will be of the wagon-top pattern, with Belpaire fireboxes and grates 66 × 44 ins. The company will order about 50 or 60 cars of a type similar to those of the Manhattan Elevated Ry. in New York, but with wider platforms and gates to allow of two passengers getting on or off together. The entrances also will be wider and provided with double doors. The trucks will be of steel, and the total length of car over platforms will be about 43 ft. The cars will have seating accommodation for 48 passengers, but will have a capacity for 100 sitting and standing. They are to be lighted by the Pintsch compressed gas system. Trains will be run at frequent intervals, and there will be a uniform fare of 5 cents. Tickets will be dropped into a box outside the waiting room, as on the New York elevated roads.

Col. C. Goddard is President of the railway company, and Mr. Robert I. Sloan, M. Am. Soc. C. E., is Chief Engineer. Mr. Sloan was formerly Chief Engineer of the Manhattan Elevated Ry., of New York, and we are indebted to him for drawings from which our illustrations have been prepared.

CONDEMNATION OF LAND FOR THE NEW WATER SUPPLY OF NEWARK, N. J.

The last section of the 4-ft. steel conduit for the new water supply of Newark, N. J., was recently laid, closing a gap of some 600 ft. in this 21-mile pipe line. This gap was across the property of one Andrew Slingerland, at Pompton Plains, who contested the right of the East Jersey Water Co., with whom Newark contracted for the new supply, to lay pipe across his land and even guarded the property, according to the daily papers, with a shot gun. Mr. Slingerland, or his attorneys, held, among other things, that the city of Newark could not exercise its right of eminent domain to condemn land to be used by the company in constructing works to be sold to the city. The case went to the Supreme Court of New Jersey, the decision of which on the above and other points is given by the Newark "Advertiser" as follows:

1. The act entitled "An act to empower cities to acquire land for public use by condemnation" (P. L. 1891, p. 172) is not a mere regulation of procedure, but is a grant of power as well.

2. The terms of said act, which authorize the condemnation of land "for any lawful public use or purpose," apply only to such public uses as the legislature has expressed or may express its willingness to promote by the power of eminent domain.

3. Said act is applicable to the condemnation of land by the city of Newark for the purpose of securing a supply of water for municipal uses.

4. The power of the city of Newark to condemn land for the purpose of supplying the municipality with water is not impaired by the fact that the city has contracted with a water company to construct and sell to the city completed water-works, of which the land sought by condemnation forms a necessary part; especially if the city has contracted to exert its power of eminent domain whenever it may be advantageously employed in furtherance of the purposes of the contract.

5. Such a condemnation is not rendered illegal by the fact that the works may not be satisfactorily completed, and therefore may never be accepted and used by the city.

6. The option to purchase water-works authorized by the proviso of the act approved April 2, 1888 (P. L. 1888, p. 366) may legally be exercised by the city before the completion of the water works for which that act provides.

7. The said option implicitly legalizes the purchase of municipal water-works and water supply.

8. The implied right of municipal corporations to give sealed evidences of indebtedness, not having the quality of commercial negotiability, for debts lawfully incurred, is unquestionable.

9. The fact that, as a natural incident to the securing by a city of a public supply of water, more water is obtained than is needed for present public uses, and that the city disposes of the surplus for an outside use, does not deprive the condemnation of land for the water supply of its public character.

For the better understanding of Section 6 of the above it may be stated that the original contract between Newark and the East Jersey Water Co. gave the city the option of buying water from the company or of buying the works. The city contracted to buy the works before they were completed. This explanation will also aid in understanding Section 5, especially when it is added that there is now an evident disagreement between the city and company regarding the removal of vegetable matter and excavations to avoid "shallow flowage." Regarding Section 8 it may be stated that the city has agreed to give $6,000,000 for 50,000,000 gallons of water, but of this amount only 27,500,000 gallons is called for until eleven years from the date of the contract. The balance the East Jersey Water Co. may dispose of as it sees fit, with some exceptions. On account of this deferred delivery of a part of the supply only $4,000,000 is to be paid on the acceptance of the works, but bonds for the remaining $2,000,000 are to be deposited with some party agreed upon, no interest to accrue until the expiration of the eleven years named above.

Under the contract Newark may sell surplus water to some outside towns, which explains Section 9.

A full description, with illustrations, of the works being built by the East Jersey Water Co. was published in Engineering News of Oct. 11, 1890, Aug. 1, 8 and 15, 1891.

A state irrigation convention opened at Helena, Mont., Jan. 8. The convention was called to consider the platform of the Salt Lake Irrigation Congress, which urges the ceding of the public lands to the several states in trust. Nothing of engineering interest had been accomplished by the convention at latest reports, but a resolution had been adopted in favor of a state irrigation and immigration commission and a state engineer.

The capacity of freight cars on the Prussian State Railways is being increased. During 1891 there were 31,750 open cars changed from 10 to 12½ tons, and all new cars are to have a capacity of 11 tons.

The approximate number of oak ties in use in Germany in 1880 was 32,000,000, while the ties from other kinds of wood amounted to 24,000,000. At present there are only 30,000,000 of oak ties used against 28,000,000 of ties from other deciduous trees and conifers. About 1% only are beech wood. France is using a greater number of beech wood ties than of conifers.

The West Side Rapid Transit Co., of Chicago, which holds a franchise for operating west on Randolph St. to Ogden Ave., and southeasterly on the avenue to the city limits, is now experimenting with a view to using electricity on the Boynton Bicycle Railway system. Their scheme is to erect an elevated structure having four single rail tracks, doing away with the steam bicycle locomotive and using large drivers directly attached to the passenger cars. The upper balancing rail is to be used as an electric conductor with a trolley running on it. Each car is to have its own motive power. The company says it expects to reach a speed of 100 miles per hour. Mr. Geo. Sherwood is President of the company, and Mr. O. W. Rodgen, General Manager. The company intends as soon as possible to build a mile or more outside the city limits for the purpose of testing the practicability of its new designs.

The river and harbor estimate to be presented to the present Congress is $60,000,000, pared down from an original estimate of $100,000,000 as presented by the Board of Engineers. A notion of this year's estimates may be gathered from the following leading items:

Harbors—New York, including Buttermilk Channel, Hell Gate, etc., $1,425,000; Buffalo, $400,000; Boston, $400,000; Sandy Bay, Cape Ann, $250,000; Point Judith, R. I., $300,000; New Haven Breakwater, $500,000; Delaware Breakwater, $300,000; Charleston, S. C., $750,000; Savannah, $1,000,000; Cleveland, $450,000; Toledo, $600,000; Humbolt, Cal., $700,000; Oakland, Cal., $500,000. Rivers—Kennebec, $300,000; Potomac, $800,000; James, $400,000; Kanawha, $500,000; Arkansas, $1,000,000; Tennessee, $2,000,000; Cumberland, $1,000,000; Ohio, $1,300,000; Hennepin Canal, $1,750,000; Lower Mississippi, $3,000,000; Upper Mississippi, $2,900,000; Missouri, $1,800,000; Sacramento, $120,000; Columbia River, Ore., $2,000,000.

PERSONALS.

Mr. Edward B. Codwise, M. Am. Soc. C. E., has been re-elected City Engineer of Kingston, N. Y.

Mr. D. M. Wheeler has resigned his position as Chief Engineer of the Winona & Southwestern Ry.

Col. George Leavitt, one of the projectors and directors of the Adirondack Ry., died at Saratoga, N. Y., Jan. 7.

Mr. L. L. Kellar has been appointed Superintendent of the Lexington & Southern Division of the Missouri Pacific Ry., vice Mr. E. Harding.

Hon. George C. Crocker, Chairman of the Massachusetts Board of Railroad Commissioners, has sent his resignation to the Governor.

Mr. W. D. Williams is Chief Engineer of the Cincinnati, Jackson & Mackinaw R. R., and not Mr. J. D. Williams, as incorrectly stated last week.

Mr. Samuel Lafever, who in 1844 built the railway from Columbus, Ind., to Madison, Ind., the first railway in the state, died at Columbus, Jan 4, aged 81.

Mr. O. O. Wheeler, formerly General Superintendent of the Fort Worth & Denver City Ry., has been appointed Superintendent of the Minneapolis Terminal Ry.

Mr. Edward Nichols, President of the Brooks Locomotive Works, Dunkirk, N. Y., died at Dunkirk Jan. 7, at the age of 41. He was a graduate civil engineer from the Rensselaer Polytechnic Institute.

Mr. W. B. W. Howe, Jr., Consulting Engineer and Architect, has removed from Savannah, Ga., to Knoxville, Tenn. He has been engineer on several Southern railways, and has had 20 years' experience.

Judge William Lindsay, of Kentucky, who was appointed by the President as a member of the Interstate Commerce Commission, to fill the place of the late Gen. Bragg, as noted last week, is said to have declined the appointment.

Mr. Austin Corbin, President of the Long Island R. R., has been elected President of the New York & New England R. R. He therefore controls the new route between Brooklyn and Boston over these two roads, with a ferry across Long Island Sound at Oyster Bay.

Messrs. Alexander Ryjoff, R. Daniewski and E. Ceglinski, Russian civil engineers connected with the proposed Siberian railway, are on their way from Vladivostock to St. Petersburg, via the United States. They report nothing new in connection with the enterprise.

Mr. P. S. Blodgett, Superintendent of the Eastern Division of the Lake Shore & Michigan Southern Ry., has been appointed Assistant General Superintendent. Mr. T. W. Niles, of the Franklin Division, succeeds him, and Mr. J. K. Russell has been appointed Superintendent of the Franklin Division.

Maj. Alexander McKenzie, U. S. Engineer Corps, has been ordered to duty in charge of the Engineer Office at Quincy, Ill., succeeding Maj. E. H. Ruffner, who has been transferred to Buffalo. Maj. Ruffner takes the place of Maj. Stickney, who has been ordered to Cincinnati to relieve Maj. D. W. Lockwood.

NEW PUBLICATIONS.

MACHINERY PATTERN MAKER. Containing Full Size Profiles of Gear Teeth and Plates, illustrating manner of constructing numerous and important patterns and core boxes. By P. S. Dingey, practical pattern maker and mechanical draftsman. New York, John Wiley & Sons; 12mo., pp. 80, 376 illustrations; 15 tables; $2.

This is one of those thoroughly practical treatises on special subjects of which Messrs. Wiley & Sons are now producing a good many. The idea of the work has been to make it a suggestive manual for those already familiar with the elements of pattern making; not to teach the whole art of pattern making to students or apprentices. Still, for that very reason, the book should be a useful manual for college instruction as well as for practical pattern makers, to many of whom it ought to be a great aid in their work on the more complex forms of patterns. A special feature of the work is a series of full size gear teeth sections for all the usual pitches from 1 in. to 3 in. pitch, advancing by ¼-in., with 14 separate teeth in each pitch suitable for gears having from 14 to 800 teeth.

NOTE SUR LES MORTIERS ET BETONS DE CIMENT Par H. Feret, chef du labratoire des Ponts et Chaussées à Boulogne-sur-mer. [Paris: 7 Rue des Beaux Arts 5; 8vo., pamph. pp. 28.

This little pamphlet embodies in small space and is based on the results of original investigations by the author.

The author first discusses the sand to be used, the methods of gaging this sand and its humidity. In the latter connection he calls attention to the fact that the packing of the sand in the gages is extremely variable, according to the degree of humidity, and he presents in tabular form a series of experiments showing the difference between dry sand and damp sand in this respect. He says that a very small proportion of water is sufficient to lower enormously the weight of sand in a cubic metre; for, with 2% of water added, the weight is decreased 20% as compared with a cubic metre of dry sand. The cause is that any humidity up to certain limits results in the grains sticking together and prevents their packing, as in dry sand. In experiments with sand and water, he used dry sand and admitted the water from below so as to drive out the air occupying the interstitial spaces. He found that one litre of sand from the Boulogne dunes, measured dry and without packing, occupied 0.888 litre when saturated with water. This proportion of course varies widely with the nature of the sand and the form and capacity of the vessel used.

He concludes from his experiments that little confidence can be placed in the common methods of determining the minimum proportion of cement which it is possible to combine with a given sand for the formation of a compact mortar. Usually the weight of this cement is calculated according to the existing voids in sand measured more or less dry and more or less packed, a volume extremely difficult to fix. For example, the voids in sand saturated and sands containing 5% of water differ as 567 to 375, or nearly as 3 to 2. He believes that the saturation test shows the minimum proportion of voids that can be filled by the cement. Sand containing pebbles presents still wider variations. The author then discusses the size and form of sand grains and their measurement for standard purposes. M. Feret decides that for compact mortar it would be very advantageous to use a mixture of two sands of very different grain volume, with as few intermediate sizes as possible. The whole discussion of the subject of sand and pebbles is so interesting that we expect later to give a fuller translation of the pamphlet of M. Feret.

SCHAEDEN AN DAMPFKESSELN, Heft I., Schaeden an Locomotiv-und Locomobilkesseln; Oesterreichischer Ingenieur und Architekten Verein; Vienna, 1891. Pamph., 4to, illustrated. 50 cents.

Section I. of this work, which bids fair to be one of much interest and value, treats of damages to locomotive and portable engine boilers. The entire treatise is on boilers only, and devoted to a study of the conditions under which defects in them originate. It explains with German care and completeness the causes of damages, their danger and prevention, the location of defects, as due to local or general changes, to fissures, cracks, fractures, bad material or faulty construction. The methods of correcting these faults are described in a practical way and shown by profuse illustrations. The work bids fair to be a valuable book of reference and a guide both to the machinist and the expert. Section II., treating upon damages on marine engine boilers, will be completed in the course of this year, it is announced.

NEW YORK AND THE WORLD'S FAIR. Paper, 8vo, pp. 61. With map of the Fair and illustrations of buildings. New York, 1892.

This publication is issued under the direction of the committee appointed by the Dry Goods Merchants of New York City to secure adequate representation of the commerce and manufactures of this State at the World's Fair. It contains the draft of a bill to be submitted to the legislature, which provides for the appointment of a commission to represent the State and for an appropriation of $500,000 to carry out the measure. There are also several pages of press extracts in favor of the State participating in the exposition. We referred to the desirability of such a step in our issue of Dec. 12, 1891, and give elsewhere in this issue the first of a series of articles upon the World's Fair.

ANNUAL MESSAGE OF LEON ABBETT, GOVERNOR OF NEW JERSEY, 1892. 8vo., pamph., pp. 104.

This message contains matter of interest regarding the public water supply of the state, including a table showing the status of public, private and all works at the end of each decade in number and population supplied. This table and other statistics relating to water-works are largely based upon figures found in the "Manual of American Water-Works," although for some reason no credit is given to that volume.

A comprehensive scheme for a gravity water supply to the cities and towns of the greater part of the state is advocated in the message and the attempt of private corporations to monopolize the water supply of the state is pronounced as dangerous to public interests.

The message contains some interesting matter regarding taxation and municipal indebtedness. The latter subject is closely connected with municipal improvements and is therefore of especial interest to engineers and contractors. The provisions relating to municipal indebtedness of the constitutions or statutes of over 30 states are abstracted in an appendix to the message and show that the general practice is to limit such indebtedness in order to prevent financial troubles and excessive taxation.

FIFTH BIENNIAL REPORT OF THE STATE ENGINEER OF COLORADO, FOR THE YEARS 1889 AND 1890. PART II. J. P. Maxwell, State Engineer; J. S. Titcomb, Deputy State Engineer. 8vo; 19 large folding plates.

Part I. of this report was reviewed in our issue of Oct. 10. Part II. consists wholly of plates, or maps and diagrams. The first eight plates present maps of the water district of the state, some of the districts taking a whole plate. The last eleven plates show graphically the daily discharge in cubic feet per second of 10 different streams;

SOCIETY PROCEEDINGS.

CIVIL ENGINEERS SOCIETY OF ST. PAUL, MINN.—At the annual meeting on Jan. 4 the following officers were elected for the current year: President, E. E. Woodman; Vice-President, J. D. Estabrook; Secretary, C. L. Annan; Treasurer, A. O. Powell; Librarian, A. Münster; Representative on Board of Managers for Association of Engineering Societies, C. J. A. Morris.

LIVERPOOL ENGINEERING SOCIETY.—At the meeting on Dec. 23, 1891, Mr. George Farren in the chair, Mr. A. W. Brightmore read a paper on "Methods of Collecting Water for Supply." He divided his subject into three parts: (1) Interception of rain water before reaching the earth by collecting it directly in tanks or from the roofs of buildings. (2) Taking the water from streams or rivers directly if the flow is sufficiently constant, or by equalizing the supply by constructing a reservoir if the supply varies below the supply required. (3) Obtaining the water from the earth's crust by means of springs, shallow wells, intercepting tunnels or drains or deep wells. He then discussed the probable state of purity of the water derived by each of these systems, and gave examples of towns and cities in Europe and America supplied on each system. He pointed out that the supply obtained by direct interception could only be very limited. With respect to the supply procured from streams or rivers it was shown to be freer from contaminating influences, if obtained near to the source of the streams, hence the advantage of a water supply from an equalizing reservoir. Referring to the third method, water collected from shallow depths by means of wells and intercepting drains was shown to be useful for supply when derived from sparsely populated districts. Water from deep seated springs or wells, owing to its infiltration through the overlying strata, is often of great purity and valuable for supply.

IOWA CIVIL ENGINEERS' AND SURVEYORS' SOCIETY.—The annual meeting was held at Burlington, Ia., Dec. 29, Mr. Wm. Steyh, Vice-President, in the chair. The following officers were elected for the year 1892: President, Wm. Steyh, Burlington; Vice-President, J. H. Cole, Keokuk; Secretary, Seth Dean, Glenwood; Directors, F. A. Macdonald and J. D. Wardle.

Papers were presented as follows: "Iron," G. Davis; "Title by Adverse Possession," Seth Dean; "Tide Lands A. B. Little; "Trials of County Surveyors," D. O. Porter; "Truss Bridges," E. M. Gilchrist; "Cost of Earthwork," J. M. Brown. The last paper was an analysis of the various elements entering into the question of moving earth by drag and wheel scrapers and wagons, as well as by steam shovels for loading cars. A resolution was adopted fixing the date of future annual meetings for the third Wednesday of January of each year. The meeting was a very interesting and successful one.

THE ENGINEERS' CLUB.—The Board of Management reports that the year 1891 has been one of satisfactory progress. The membership of the club has been increased to a total of 587 members, of whom 282 are resident and 305 non-resident members; 101 new members were elected; there were 18 resignations and four deaths during the year. The income of the club has been $33,120, and the expenditures $41,461, leaving $3,571 in hand, as against $5 913 last year. The Board estimate that the expenditures for the ensuing year should fall below those of the past year, which have been rendered larger than usual by reason of improvements to the house and additions to the furniture and equipment. It should also be noted that the sickness and death of the steward in the early part of the year involved the club in considerable expense. The fortnightly dinners, so auspiciously inaugurated last year, have continued with resulting benefit to the club. The unusual proportion of non-resident members will be noticed. As the income necessary to sustain the club in an efficient manner must be expected to come principally from the resident members, it is desirable that an effort be made to judiciously increase this class of membership.

Charles Macdonald, President.
David Williams, Secretary.

Treasurer's Report for the Year 1891.

Receipts.

Initiation fees	$1,600
Dues	14,398
Rent of rooms	2,027
Restaurant	18,035
Cash on hand Jan. 1, 1891	5,913
	$48,033

Disbursements.

Furniture and draperies, etc.	$1,402
Kitchen utensils, crockery, glassware, etc.	576
Rent and water tax	5,811
House improvements	1,154
Fuel, gas, electric light	1,986
Entertainments	579
Periodicals	402
Miscellaneous expenses	3,116
For settlement of contract with A. E. Girardin	1,000
For balance due A. E. Girardin, 1890	644
Restaurant account	21,107
Wages	3,881
	$41,461

COMING TECHNICAL MEETINGS.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 18. Secy., S. E. Tinkham, City Hall.
WESTERN RAILWAY CLUB.
Jan. 19. Rookery Building, Chicago. Secy., W. H. Marshall.
"M. C. B. Standards," "American Railway Rolling Stock."
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Jan. 19. Secy., J. H. Harlow, Pittsburg, Pa.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 20. Secy., Arthur Thatcher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 20. Secy., F. Collingwood, 127 East 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 21. Secy., H. T. Bovey, 112 Mansfield St., Montreal, P. Q.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 21 Secy., J. F. Wilson.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Jan. 21. Secy., T. G. Pihlfeldt, 113 Adams St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Jan. 21. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
Jan. 21. Rooms of Am. Soc. M. E., 12 W. 31st St.
"Air Brakes in Freight Service."
DENVER SOCIETY OF CIVIL ENGINEERS.
Jan. 23 Secy., Geo. H. Angell, Jacobson Block.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 1. Secy., C. L. Annan.
ENGINEERS' CLUB OF KANSAS CITY.
Feb. 1. Baird Building. Secy., H. Goldmark.
WESTERN SOCIETY OF ENGINEERS.
Feb. 3. Secy., J. W. Weston, 230 La Salle St., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 4. Public Library Bldg. Secy., F. W. Cappelen.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Feb. 5. Secy., E. K. Smoot, 806 Commerce St.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 5 Secy., A. H. Porter, 50 Euclid Ave.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 5. Secy., O. von Geldern. 319 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
Feb. 6. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 6. 1122 Girard St. Secy., J. C. Trautwine.
NORTHWEST RAILROAD CLUB.
Feb. 6. Union Station, St. Paul.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Feb. 9. Secy., Parker N. Black, Capitol Block.
NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 9. Occidental Block, Seattle. Secy., E. H. Warner.
CIVIL ENGINEERS ASSOCIATION OF KANSAS.
Feb. 10. Secy., J. C. Herring, Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Feb. 10. United States Hotel, Boston. Secy., F. M. Curtis.
"Locomotive Boilers and Their Attachments."
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
Feb. 11. Secy., O. H. Landreth, Nashville, Tenn.
TECHNICAL SOCIETY OF NEW YORK.
Feb. 11. 194 Third Ave. "Boiler Plant."
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Feb. 19. Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 20. Helena.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST..... .....BUSINESS MANAGER

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The date when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance. No other receipt is sent unless requested.

ADVERTISING RATES, 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Tuesday afternoon; new advertisements, Wednesday afternoon; transient advertisements, not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

There appears in the last issue of a railway journal of this city, which, as such, might be too hastily assumed to know what it is talking about before it talks about it, the following statement, in which it wrongfully attempts to correct this journal; its own error being one which just at this time is likely to do especial harm, by misinforming the public as to the progress already made in the introduction of block signaling. We italicize two or three of the more amazing statements in this short paragraph:

Among the other misinformation which came out in the discussion of the Hastings collision, was the statement in a technical contemporary that the Providence & Worcester (now a division of the New York, Providence & Boston) had been equipped with automatic block signals for its entire length since 1881—ten years. The radical error is that the Providence & Worcester *has no block system, except on about six miles at the Providence end. Electric track-circuit signals* (the clockwork system of the Union Switch & Signal Co.) *are in use at each station for local protection*, but most of these were put in during 1882, or later. A track circuit signal is an admirable protection for a station; but in comparing the Providence & Worcester with the New York Central it is no more than fair to state that the latter several years [ago] equipped its switches with distant signals, *thus affording good protection* for most stations; and if we mistake not the stations without switches were equipped with *the same kind of signals—hand-operated semaphores.* The Providence & Worcester deserves credit for putting in the automatic signals, but the New York Central also deserves credit for its man-operated signals, *and the difference in degree of credit is not so great.*

The substratum of truth in this statement is that the block system of the Providence & Worcester, though practically continuous and complete over the whole line, and so reported and described by the manufacturers, management of the road, and railroad commissioner of the state, does not completely cover certain sections of open track between the stations, though it does constitute and was worked as an automatic block signal system throughout, so long ago as 1884, as will appear from statements from the manufacturers in our contemporary's own columns of Sept. 19, 1884, and Nov. 28, 1885. Moreover, although this system was planned, ordered, and in part erected in 1881, we find that its installment was not completed until the latter part of 1883. The report of the superintendent of the road to the railroad commissioner of the state dated Jan. 11, 1884, not only describes this system as complete in the fullest sense over the whole main line, but is of unique interest at this time in the full details which it gives of the exact working of the plant; of the extent to which it failed in service from carelessness or imperfections, and of the number of cases in which it proved an effective and needed protection. We therefore reprint this report, which has never before appeared to our knowledge in any technical journal, in another column.

Our contemporary is entirely in error in stating that these signals are erected only at stations. There are also a number of intermediate stations, as will appear from a letter from the chief engineer of the road in another column. But to show that the "signals in use at each station" are alone enough to furnish a sufficient block signal plant, when worked as such, as they are shown elsewhere to be, we need only say that there are no less than 15 intermediate stations, or 17 stations in all, on this disputed distance of 57¼ miles, or an average of only 2.34 miles, apart without considering the intermediate blocks. Now the blocks on the newly planned Sykes system for the New York Central, according to the statement of President Depew on p. 33 of our last issue, average 1½ miles (one being 2.08 miles) each from Yonkers to Oscawana, 22 miles; 2¼ miles each between Peekskill and Poughkeepsie, 31 miles, and 1.72 miles each from Poughkeepsie to Albany, all this being for a vastly heavier traffic and over a much worse alinement than that of the Providence & Worcester.

It will be seen, therefore, that they have, and have had since 1881-3, as many block signal stations as they can ever have any use for. To compare such a system with the hand worked station semaphores on the New York Central, and to declare that the two roads deserve nearly equal credit, and obtain nearly equal protection from them, or any approach to equal protection, is the height of folly and unfairness; especially when we remember that this automatic track circuit system is, so far as protection against trains is concerned, absolutely the most perfect of all. Even the admirable Sykes system may fail in the remote (but by no means impossible) contingency of three signalmen at once losing their heads. As many as seven men at once have been known to lose their heads, and thus cause an accident which any one might have prevented. The original form of the block system, in which each man controlled his own signals absolutely, may fail if any one man loses his head, as happened in the Meadows disaster on the Pennsylvania Railroad, just out of Jersey City, some years ago. But the worst fault of the automatic track circuit system is that it sometimes over-protects by showing danger when there is none, except some failure of its own; and it is this fault only which has prevented it from obtaining preference over any and all other block systems, as its cost is not great, amounting only to some $130 per signal per year, as will appear from some figures given by the chief engineer of the road in another column.

On the other hand, it may serve as a useful purpose to show more fully than our space permitted in our issue of Jan. 2 just what protection was obtained from the hand worked station semaphores, which our contemporary is not ashamed to declare gave a "good protection."

It will be remembered (see our issue of Jan. 2) that the Hastings collision occurred between the St. Louis express, leaving New York at 8 p. m. and due to pass Hastings about 8:30 p. m., and the Niagara Falls express, which had left New York at 7:30 p. m. The situation between Hastings and Sing Sing was then as follows, Sing Sing being 31 miles from New York, and trains being designated by their time of leaving New York:

SING SING, where first accident occurred (about 6:00 p. m.), blocking both tracks.

Six miles.
- 6:00, Chicago express from New York, which had been switched around and ahead of locals.
- 4:59, local.
- 5:10, local.
- 5:25, local.
- 5:40, local.

} Four trains held up by block at Sing Sing.

TARRYTOWN.

Four miles.
- 6:10, local.

DOBBS FERRY.

Two miles.
- Dobbs Ferry semaphore.
- 6:25, Montreal express.
- 6:40, local (arr. ved about 7:30, half an hour before St. Louis express was sent out.
- 7:30, Niagara Falls express, arrived here at 8:17; wrecked by St. Louis express at 8:41 p. m.

} All held up by orders from New York.

(7:35, local, next regular train due, was held back at New York without any notice being sent out along the line.)

HASTINGS.

Hastings semaphore; at safety at 8:15, when Niagara Falls express passed, then set to danger for five minutes; then to caution for five minutes; then, at 8:25, set to safety, about the time when brakesman Herrick came back with his red lantern and went into the station, letting St. Louis express by about 8:39, which collided with 7:30 express at 8:41.

This was the situation which had been shaping itself for 2¾ hours between four stations averaging three miles apart, each of them with station semaphore signals, telegraph operators and agents, all in telegraphic communication with each other and with the dispatcher's office, and hence readily capable (except for the element of human carelessness, against which there was no check) of conversion into an improvised "permissive block" signal system for the protection of delayed trains, without holding them back too far.

It would appear from the evidence that the trains had been so protected above Dobbs Ferry by station semaphores set at danger, but nothing in the testimony shows that the Dobbs Ferry agent did anything to warn Hastings as to there being three trains held up between them, nor did the Hastings agent, who had seen one express held up in front of his station, while three brakesmen had passed it with danger signals, do anything to protect them; nor did the train dispatcher, who knew that for 2¾ hours 10 stalled trains had been accumulating below Sing Sing, do anything to protect them or see that they were protected. The entire reliance of the working staff, from the train dispatcher down, seems to have been placed on there being a rear brakesman on each train who would have time to go back far enough and not forget to, who would not stumble or break his leg, who would have a red lantern lighted which would not go out, and who would certainly be seen by the next following train. We do not care to comment on these facts. We content ourselves with recording them.

It may be claimed that all this is nothing against the semaphores, but only against the way in which they are used; but that is not true. Experience proved long ago that this is the way in which all such systems which rely on the unchecked faithfulness of single men for their efficiency invariably tend to work. It is not enough that a signal system will work safely if "every man does his duty." It must work safely whether each does his duty or not, to be fit for use on a crowded road.

At the hearing in this city a few weeks ago on Safety Appliances, by the Committee appointed by the Convention of State Railroad Commissioners, it will be remembered that the Grand Master and a committee from the Switchmen's Mutual Aid Association of North America appeared and took a decided stand against the M. C. B. coupler. Backed up by Mr. John Hall, representing the Safford coupler, they declared in favor of "a link-and-pin coupler with recess in face of drawhead for protection of hands." There was some astonishment at this expression on the part of the switchmen, a class of employees which is most vitally interested in the introduction of automatic couplers. It has just come to our notice that this same society, "The Switchmen's Mutual Aid Association of North America," at its convention in 1889 adopted the following resolution:

Resolved, That this convention of switchmen appeal to Judge Cooley, chairman of the Interstate Commerce Commission, to use his utmost power to cause all railways in the United States to adopt a uniform automatic car coupler.

As we have before said, the opinion of the ordinary run of employees on a matter of this sort is not of much value, especially when that opinion is expressed by the officials of a labor organization. It is of interest to note, however, that the position taken by Grand Master Sweeny and his associates is directly contrary to that taken by the organization of which he is the head only two years ago. The motives which led these men to come forward in defence of the link-and-pin type at this time, without regard to the action of their association a few months ago, can be conjectured.

The United States is a broad territory, and its multitude of public improvements has developed a class of intelligent, wealthy and energetic contractors who are second to none from a standpoint of personal ability and achievements. But in the cosmopolitan

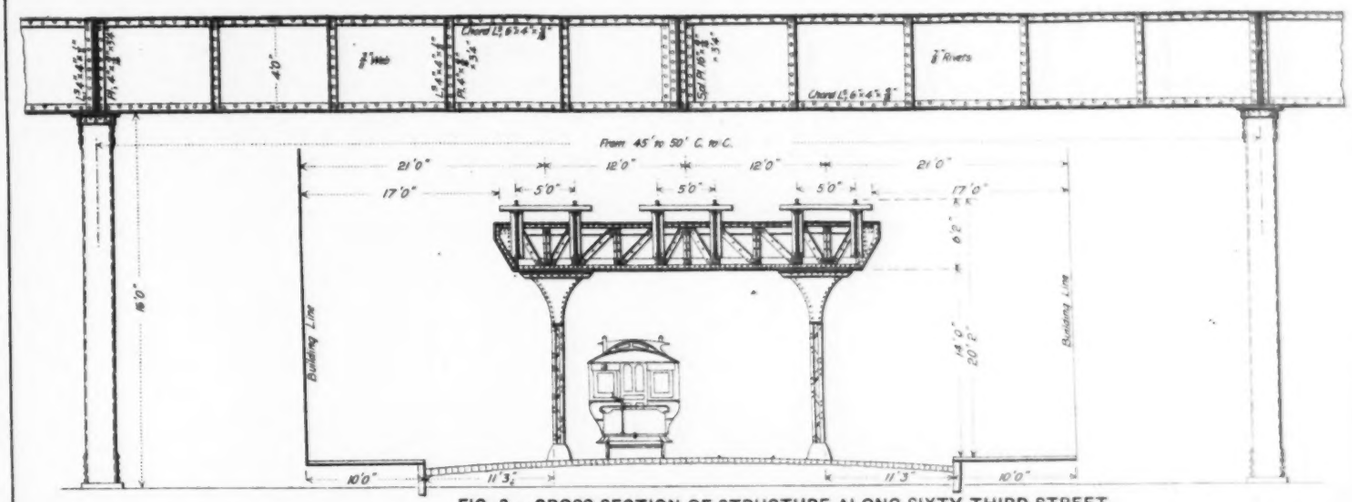
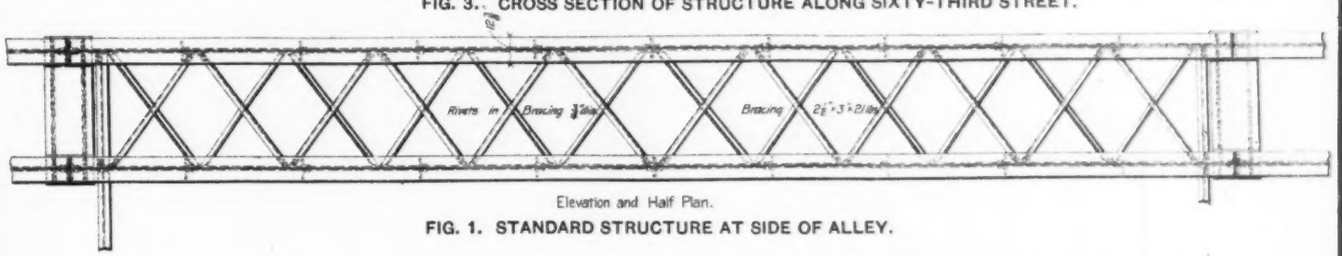


FIG. 3. CROSS SECTION OF STRUCTURE ALONG SIXTY-THIRD STREET.



Elevation and Half Plan.

FIG. 1. STANDARD STRUCTURE AT SIDE OF ALLEY.

Longitudinal span c. to c. of supports.	Max. B. moment per track, moving load.	Max. B. moment per track, dead load.	Max. B. moment per track, comb'd D. and L. loads.	Max. B. moment per girder, combined D. and L. loads.	Depth of girders.	Max. chord strain, comb'd L. and D. loads.	Allow'd stress per sq. in.	Net chord section.	Composition of chords. (Angle irons.)	Equiv. wt. per lin. ft.
ft.	ft.-lbs.	ft.-lbs.	ft.-lbs.	ft.-lbs.	ins.	lbs.	lbs.	sq.in.	ins.	lbs.
35 to 40	375,675	108,520	484,195	242,097	42	73,362	9,000	8.15	6 × 4 ×	
40 to 45	450,665	135,900	586,555	293,327	48	74,441	"	8.27	6 × 4 ×	
45 to 50	525,640	176,125	701,765	350,882	48	89,969	"	9.99	6 × 4 ×	
50 to 55	600,637	238,040	838,677	419,338	48	107,522	"	11.94	6 × 4 ×	
55 to 60	675,625	311,520	987,146	493,573	54	114,784	"	12.75	6 × 6 ×	
60 to 65	750,618	365,625	1,116,243	558,121	54	129,795	"	14.42	6 × 6 ×	

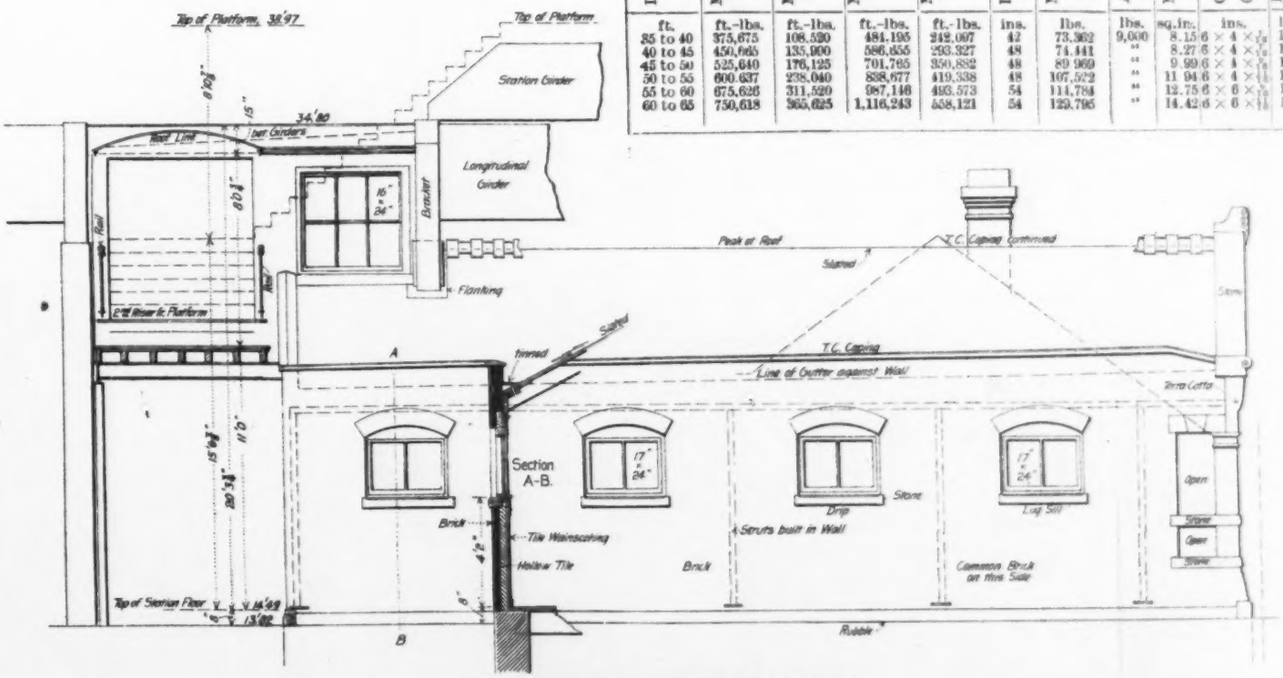


FIG. 7. WEST SIDE ELEVATION OF STATION.

ELEVATED RAILWAY AND TWENTY-SIXTH STREET ST

C. GODDARD, PRESIDENT.

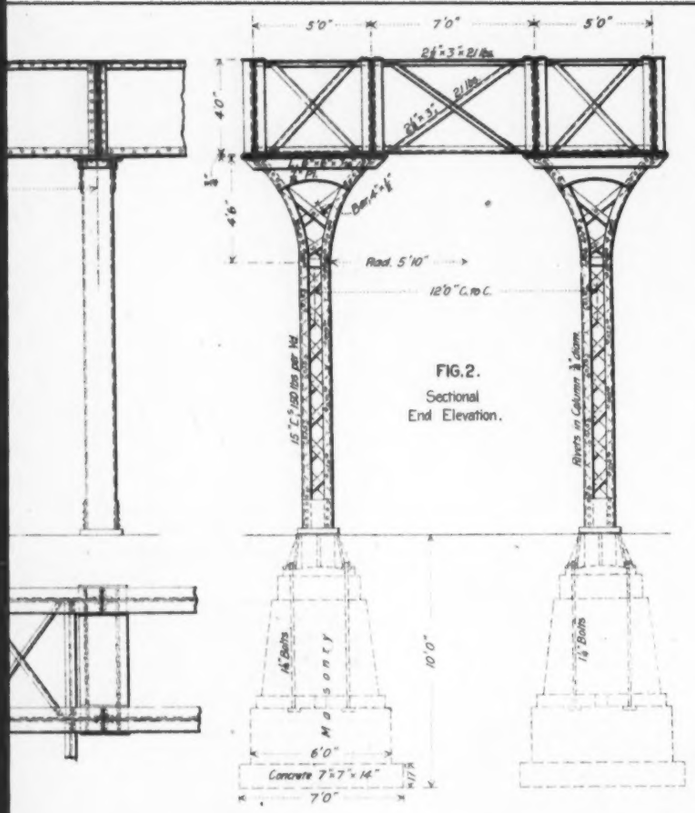


FIG. 2.
Sectional
End Elevation.

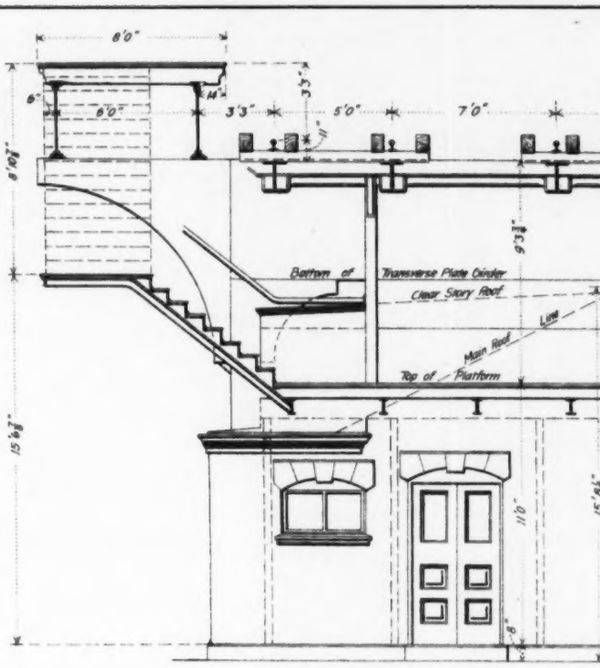
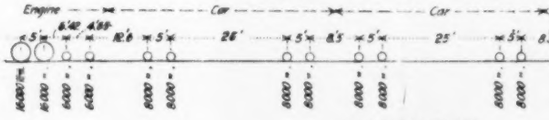


FIG. 8. REAR ELEVATION OF STAT



LOAD DIAGRAM.

Allow'd stress per sq. in.	Net chord section.	Composition of chords. (Angle irons.)	Equiv. wt. per lin. ft. per girder.	Max. shear in web.	Thickness of web.	Equiv. distributed load.
lbs.	sq. in.	ins.	lbs.	lbs.	ins.	lbs.
9,000	8.15	6 × 4 × 7/16	1,210	24,200	3/8	48,400
"	8.27	6 × 4 × 9/16	1,158	26,055	7/16	52,110
"	9.99	6 × 4 × 11/16	1,122	27,550	7/16	55,100
"	11.94	6 × 4 × 13/16	1,109	30,497	1/2	60,995
"	12.75	6 × 6 × 9/16	1,096	32,880	7/16	65,760
"	14.42	6 × 6 × 11/16	1,056	34,320	1/2	68,640

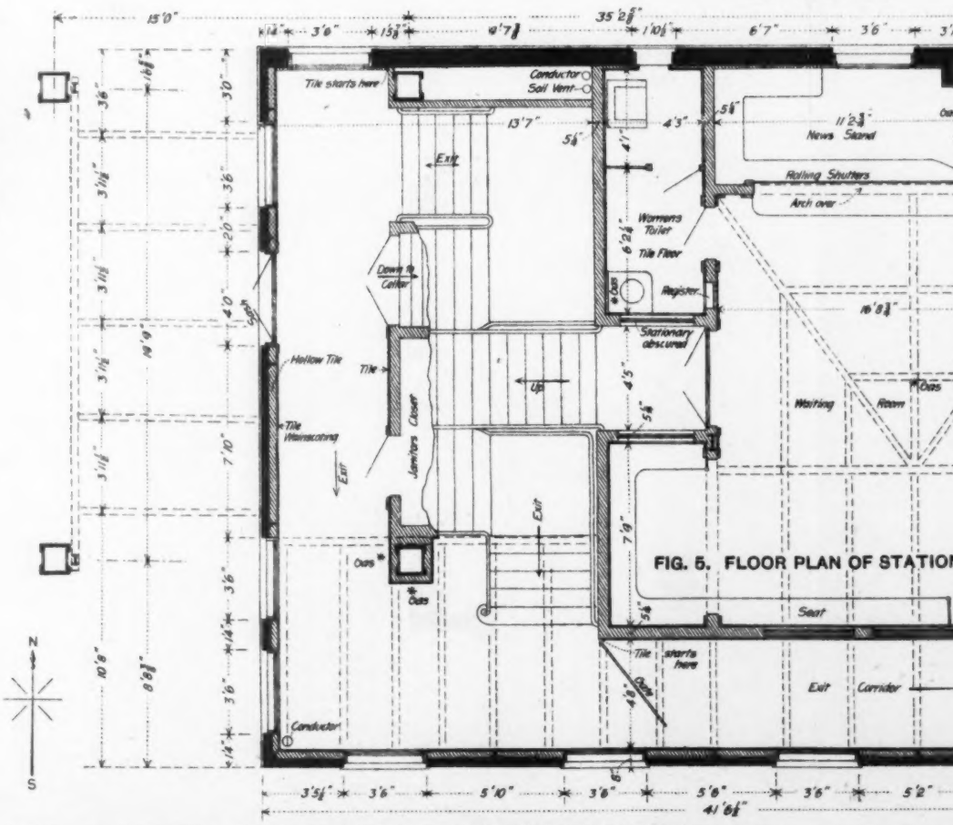
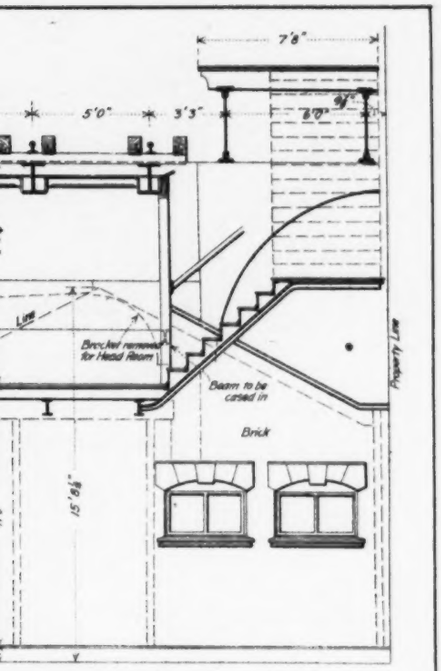


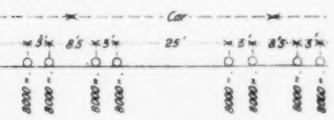
FIG. 5. FLOOR PLAN OF STATION

STREET STATION; CHICAGO & SOUTH SIDE RAPID TRANSIT RAILROAD CO.

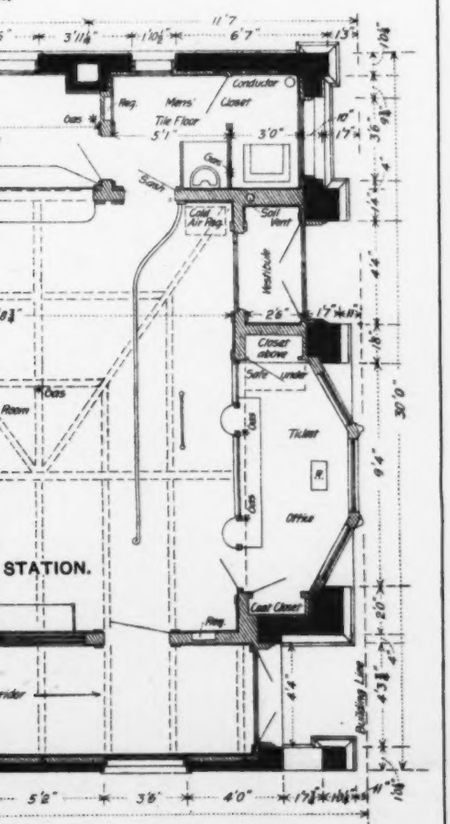
R. I. SLOAN, M. AM. SOC. C. E., CHIEF ENGINEER.



OF STATION.



M.



STATION.

CHAS. HART & SONS, LITH., 30 VESEY ST., N. Y.

character of their work, these contractors must yield the palm to some of their English brethren, to nom "the world is mine oyster." In a late obituary of Mr. William Henry Punchard, of the London contracting firm of Punchard, McTaggart, Lowther & Co., we notice that, though only 56 years of age, he had been engaged on public works in England, Canada, Nova Scotia, Venezuela, Peru, Brazil, the Argentine Republic, Uruguay, Sweden, Russia, Spain, Malta, South Australia and Tasmania. When the energetic work is considered that was requisite to secure these concessions or contracts, to gather and ship the necessary plant, and to organize and conduct these remote enterprizes with widely differing personnel, the name of Mr. Punchard is eminently suggestive of his methods.

Fortunately, perhaps, the United States is still broad and active enough to give employment to its contractors at home. The Englishman has the advantage that English capitalists, who furnish the bulk of the cash represented by the enterprises named in the list, naturally prefer that the material should come from England and the profit accrue to Englishmen when there is a profit. But the fact remains that Englishmen invest their money everywhere and English engineers and contractors follow the investment. As a development of remote sources of wealth is the true incentive after all, and each investor and builder expects a profit, whether he gets it or not, there is evidently a field abroad that might be more carefully studied by American capitalists and contractors.

As showing how doctors will disagree on questions of interpretation like that in regard to the "northwest point" of Lake Quinaielt, in our last two issues, Mr. F. H. Dabney, Chief Engineer of the Yazoo-Mississippi Delta Levee District, who ought to be good authority on such questions, sends us a letter based upon the showing of facts in our first communication, maintaining that the true "northwest point" would have to be taken as neither the point A (the most northerly point) nor the point B (the most westerly), but at some assumed point midway between them, where there is nothing resembling a point of the lake. We do not publish his letter, as the letter which appeared in our last issue changed the whole nature of the problem by showing that old sketch maps at least existed, issued by government authority, and by clear implication binding it, as one party to the deed, to the description which favors the other party. Neither would it now be worth while to discuss the question of interretation as originally submitted, but we are unable to agree with Mr. Dabney.

Elsewhere in this issue we abstract the matter of principal interest in the report of the Statistician to the Interstate Commerce Commission, which will form by far the most complete body of statistics concerning the railways of the United States ever published. The complete report will make a volume of about 875 pages, or over one-third more matter than last year. A new departure has been made by giving statistics not alone for the whole United States, but for the different sections separately; and while the territorial grouping adopted is subject to criticism, it is a very great step in advance that some grouping has been adopted. As an example of the results which have been developed by the adoption of this system, the accident statistics, when compiled by groups, show fewer accidents to passengers in proportion to the traffic in the states east of Chicago and north of the Ohio and Potomac Rivers than in any other section of the country. The greatest proportion of accidents to both passengers and employees is found in the states south of the Ohio and east of the Mississippi. The statistician suggests that this is due to "poorer road-beds and an inferior grade of management."

As another example of the value of classifying statistics geographically, we may take the average freight carried per freight train, which is shown to vary from 122 tons in the New England States to 218 tons in the section lying between Chicago and New York City. In the same way the average number of passengers per train varies from 62 in New England to 33 to 40 in the South and Southwest. In this connection it is of interest to note that the cost of carrying a passenger a mile is less in New England than any other section of the country, being only 1.463 cts., while in every other section, except the states between Chicago and New York City, the cost is over 2 cts. Similarly the cost of carrying freight is least in Ohio, Indiana and Illinois, being only 0.470 ct. per ton mile, while in New England it reaches 0.949 ct. On the table from which these last figures are taken, the Statistician makes the following comment:

> It is believed that gradients and curves and other physical conditions have commonly received greater consideration than they are entitled to as elements determining cost of traffic; density of traffic, which permits economy in loading trains [and has little effect in increasing many of the fixed expenses of operating—Ed.] and the character of the freight carried exert a decidedly more potent influence.

All very good; but let no man (especially no engineer) deceive himself with the idea that gradients and curves, especially the former, are not potent influences in determining cost of traffic. It is certain that density of traffic is as a rule the most important factor in determining cost of carriage; but it is equally certain that the evil effect of steep ruling grades is not appreciated either, by the generality of railway builders.

CONSUMPTION OF WATER AND USE OF METERS.

In no department of water-works construction and management, it seems safe to say, is there a greater chance for improvement and economy than in connection with an increased use of meters. In submitting reports and estimates for new works engineers seldom, if ever, include the item of meters, although in the long run it would undoubtedly prove wise if this were done and meters considered as a part of the works. It is true that meters, like service connections, are put in after the main works are completed, and, also like the services, are perhaps more often than otherwise paid for directly by the consumer, or else are rented to him. But meters play so important a part in reducing or keeping down the consumption of water, and consequently the necessary size and corresponding cost of water-works, that they should be introduced at the start, considered a part of the system, and their cost included in the general construction account.

Works already in existence would do well when adding meters to charge their cost to the general construction account. In the case of both old and new works the opposition on the part of consumers would undoubtedly be greatly lessened if the course just named were adopted and the charge to the consumer for the introduction of a meter, or the irksome annual rental often imposed, were thus done away with or avoided from the start. An additional consideration of great importance is that if the meters were the property of the water department or company they would be repaired without direct charge to the consumer, and thus unpleasant words would be avoided when the meters were inspected and repairs found necessary, and opposition to their use would be still further lessened. Perhaps of still greater importance would be the city's or company's unrestricted and unquestioned privilege to select just such a meter as it saw fit for any particular service connection, instead of, as is often the case, allowing the consumer to select such a meter as he sees fit, in which case cheapness rather than efficiency is the basis of the choice.

That there is a wide field open for the introduction of meters is shown by the facts regarding their use or non-use collected for our "Manual of American Water-Works" and set forth below, especially in Tables 7 and 8-S. The first named table gives a summary by states and groups of states regarding the use of meters and their ratio to the total number of taps in use. The second table is designed to aid in a study of the effects of meters upon the consumption of water.

Before considering the tables in detail it may be said that the statement regarding the field for the introduction of meters is borne out by the following facts regarding the United States as a whole: Of 2,037 water-works only 98 have 20 per cent. or over of their taps metered, and these 98 works have about 61 per cent. of all the meters reported, or 109,474 out of a total of 163,178. It might be thought that these works taken together include a majority of all the taps in the United States, but this is not the case, the 98 works reporting but 281,967 out of a total of 2,212,913 taps, or only 13 per cent., against the 61 per cent. of meters on the same 98 works. The very small number of meters in use by some of the largest cities is shown by the first part of Table 8-S, from which it will be seen that but 8 of the 50 largest cities of the United States have 20 per cent. or over of their taps metered.

The general practice in the several states is shown by Table 7-S, referred to above. This table gives for each state the number of meters and taps and per cent. of taps metered; also the number of works reporting meters in use, number reporting no meters and number not reporting; also the total number of works in each state and the percentage of these which report meters.

For the whole country it will be seen that 877 works report meters in use (one or more), or 43.1 per cent. of all the works; 578 works report no meters, and 582 make no statement. While the number of works repotting meters in use is fairly large compared with the total, it is evident from the percentage of taps metered, 7.4 for the United States, and the fact that 61 per cent. of all meters are on the works having 20 per cent. or more of their taps metered, that many of the works reporting meters have but few in use; in fact, there are at least 100 with only one, and several others with but two or three meters.

By groups of states the Pacific has the largest percentage of its taps metered, 14.8, and New England next, its percentage being nearly the same, 14.1. The percentages in the other groups range from 8.2 in the South Atlantic to 4.5 per cent. in the North Central, the figures for the whole United States being, as stated, 7.4 per cent. Canada has but 1.7 per cent. of its taps metered, only one works, Cote St. Antoine, P. Q., reporting over 20 per cent. of its taps metered.

By states Rhode Island has by far the largest percentage of taps metered, 55.6 per cent. But a large part of all the taps in the state, 78 per cent., are on three works, the figures for these works and the state being as follows:

	Taps.	Meters.	Per cent. of taps metered
Providence	14,896	9,286	62.4
Pawtucket	5,322	3,539	65.5
Woonsocket	1,117	924	82.7
Total	21,335	13,749	64.4
Whole state	27,055	15,036	55.6

Pennsylvania has but 0.6 per cent. of its taps metered, 74 works, or 34 per cent. of the total, reporting but 2,194 meters, or an average of less than 30 each, and no works having as many as 20 per cent. metered. Some of the smaller states report a less percentage of meters, and Utah and Idaho report none, but from the great state of Pennsylvania, with its 216 works, better things might well have been expected.

Philadelphia, with its 170,911 taps, nearly half of the total for the state, has but 522 meters, 0.3 per cent. of its taps. Chicago, also, reports but a few meters, 3,924 for at least 170,000 taps, the exact number not being known. New York has 20.2 per cent. of its taps metered, and an average daily consumption per inhabitant of but 79 gallons, while Chicago has a per inhabitant consumption of 138, and Philadelphia of 132 gallons. True, New York would have used more water in the first half of 1890 had it been available to consumers, but during the latter half of the year, or a great part of it, an ample supply was furnished.

Chicago and Philadelphia have the largest water-works pumping plants in the country, if not in the world, the combined daily capacity of all the pumps at Philadelphia at the close of 1890 having been 185,200,000 and at Chicago 218,000,000 gallons, the latter figures including pumps with a capacity of 20,000,000 gallons, for which water was not always available. In addition Chicago had 42,000,000 gallons pumping capacity not yet accepted, and both cities let contracts in 1891 for more pumps, those at Chicago to be primarily for use at the Columbian Exposition. In 1890 the total average daily consumption at Chicago was 152,000,000 and at Philadelphia 138,000,000 gallons.

It may well be asked why do not these cities, and many others with a showing proportionately bad or

Table 8-S.—Consumption of Water and Use of Meters in the Fifty Largest Cities of the United States and in all Other Cities, Towns or Villages Having Fifty Per Cent. or More of their Taps Metered.

Fifty Largest Cities.

	Population, 1890.*	Ownership.	Source.†	Mode.†	Number taps.	Number meters.	P. c. taps metered	Pop'n per tap.	Daily consumption. Total.	Per inhabitant.	Per tap.
1. New York	1,515,301	Pub.	S.	G.	108,884	22,072	20.2	13.9	121,000,000	79	1,111
2. Chicago[1]	1,099,850 (1,085,000)	Pub.	L.	P.	.....	3,924	.....	.....	152,372,288	140	.....
3. Philadelphia[2]	1,046,964 (1,040,000)	Pub.	S.	P.	170,911	522	0.3	6.1	137,736,703	132	806
4. Brooklyn[3]	806,343	Pub.	.....	P.	80,493	2,263	2.5	8.7	55,000,000	72	616
	29,505	Co.	S., U.	P.	3,732	.....	.....	7.9	.....	.....	.....
5. St. Louis[4]	451,770	Pub.	S., U.	P.	38,183	3,115	8.2	11.8	32,479,000	72	851
6. Boston[5]	448,477 (527,000)	Pub.	L., S.	G., P.	80,258	4,018	5	6.6	42,173,100	80	525
7. Baltimore	434,439	Pub.	S.	G.	74,778	913	0.1	5.8	40,978,229	94	548
8. San Francisco[6]	298,997	Co.	S.	G.	30,200	12,505	41.4	9.9	18,350,000	61	608
9. Cincinnati[7]	296,908 (302,581)	Pub.	S.	P.	35,430	1,451	4.1	8.5	33,997,007	112	959
10. Cleveland[8]	261,353 (270,055)	Pub.	L.	P.	30,938	1,794	5.8	8.7	27,787,158	103	898
11. Buffalo	255,634	Pub.	S.	P.	40,331	94	0.2	6.3	47,517,137	186	1,178
12. New Orleans[9]	242,039	Co.	S.	P.	4,450	20	0.4	54	8,976,715	37	2,017
13. Pittsburg[10]	238,617	Pub.	S.	P.	25,050	57	0.2	.....	36,000,000	144	.....
		Co.	S.	P.	7,851	"Few."	.....	8.2	11,509,000	153	1,467
14. Washington[11]	230,392	Pub.	S.	G., P.	35,404	98	0.3	6.5	36,588,629	158	1,033
15. Detroit	205,876	Pub.	S.	P.	40,351	856	2.1	5.1	33,208,067	161	823
16. Milwaukee	204,468	Pub.	L.	P.	18,422	5,876	31.9	11.1	22,380,783	110	1,215
17. Newark[12]	181,830 (185,317)	Pub.	S.	P.	21,532	520	2.4	8.6	14,079,793	76	654
18. Minneapolis	164,738	Pub.	S.	P.	9,990	633	6.3	16.5	12,416,117	75	1,243
19. Jersey City[13]	163,003 (197,438)	Pub.	S.	P.	20,456	240	1.2	.....	19,300,000	97	.....
21. Louisville[14]	161,129	Co.	S.	P.	13,512	792	5.9	11.9	11,874,688	74	879
21. Omaha[15]	140,452 (148,478)	Co.	S.	P.	6,193	1,200	19.4	24.	14,000,000	94	2,261
22. Rochester[16]	133,896	Pub.	L., S.	G., P.	24,868	2,844	11.4	5.4	8,800,000	66	354
23. St. Paul	133,156	Pub.	L.	G., P.	10,458	440	4.2	12.7	8,000,000	60	765
24. Kansas City[17]	132,716 (171,032)	Co.	S.	P.	11,198	1,971	17.6	15.3	12,000,000	71	1,071
25. Providence[18]	132,146 (140,000)	Pub.	S.	P.	14,896	9,286	62.4	9.4	6,743,092	48	453
26. Denver	106,713	Co.	U.	P., G.	10,792	85	0.8	.....	15,000,000	.....	1,381
		Co.	U.	P.	4,500	.....	.....	.....	5,000,000	.....	1,111
27. Indianapolis	105,436	Co.	S.	P.	2,963	226	7.6	35.6	7,500,000	71	2,537
28. Allegheny	105,287	Pub.	S.	P.	15,000	0	0	7	25,000,000	238	1,666
29. Albany[19]	94,923	Pub.	S.	G., P.	15,375	60	0.4	6.2	Unknown.	.....	.....
30. Columbus	88,150	Pub.	U.	P.	7,649	491	6.4	11.5	6,882,333	78	900
31. Syracuse[20]	88,143	Co.	S.	G., P.	4,100	660	14.6	21.5	6,000,000	68	1,464
32. Worcester	84,655	Pub.	S.	G.	9,450	8,451	89.4	8.9	4,971,340	59	526
33. Toledo	81,434	Pub.	S.	P.	4,374	411	9.4	18.6	5,842,768	72	1,336
34. Richmond	81,388	Pub.	S.	P.	10,383	143	1.4	7.9	13,597,102	167	1,310
35. New Haven	81,298	Co.	S.	P.	.....	60	.....	.....	11,000,000	135	.....
36. Paterson	78,347	Co.	S.	P.	6,648	2	.....	11.8	10,000,000	128	1,503
37. Lowell	77,696	Pub.	S.	P.	8,471	1,935	22.9	9.2	5,127,199	66	605
38. Nashville[21]	76,168	Pub.	S.	P.	5,098	40	0.8	14.9	11,153,885	146	2,188
39. Scranton	75,215	Pub.	S.	G.	1,761	0	.....	.....	2,500,000	.....	1,417
		Co.	S.	G.	.....	.....	.....	.....	.....	.....	.....
40. Fall River	74,398	Pub.	L.	G.	4,980	3,717	74.6	14.9	2,136,182	29	429
41. Cambridge	70,028	Pub.	S.	G., P.	10,554	254	2.4	6.6	4,489,180	64	425
42. Atlanta	65,533	Pub.	S.	P.	3,273	2,934	89.6	20.0	2,359,564	36	721
43. Memphis	64,495	Co.	U.	P.	5,400	200	3.7	11.9	8,000,000	124	1,482
44. Wilmington	61,431	Pub.	S.	P.	12,238	28	0.2	5	6,934,912	113	567
45. Dayton	61,220	Pub.	U.	P.	3,044	117	3.8	20.1	2,848,926	47	936
46. Troy	60,956	Pub.	S.	P.	5,786	226	3.9	10.5	7,608,468	125	1,315
47. Grand Rapids[22]	60,278	Co.	U.	P.	1,600	150	15	.....	.....	.....	.....
		Pub.	S.	P.	3,819	459	12.0	.....	4,392,193	.....	1,150
48. Reading	58,661	Pub.	S.	P.	10,000	6	0.1	5.8	5,000,000	75	439
49. Camden[23]	58,313	Pub.	S.	P.	12,336	10	.....	.....	7,960,000	131	.....
50. Trenton[24]	57,458	Pub.	S.	P.	9,500	46	.....	6.	3,569,150	62	376

Cities not Included Above Having Fifty Per Cent. or More of their Taps Metered.

Hoboken, N. J.[25]	48,546 (87,163)	Co.	S.	P.	7,249	4,635	62.4	12.2	5,527,000	63	762
Des Moines, Ia.	50,093	Co.	S.	P.	2,500	1,500	60	20	2,750,000	55	1,100
Pawtucket, R. I.[26]	23,667 (50,000)	Pub.	S.	P.	5,322	3,539	66.5	9.4	3,216,555	64	604
Utica, N. Y.	44,007	Co.	S.	G.	3,000	2,500	83.3	14.6	.....	.....	.....
Yonkers, N. Y.	32,033	Pub.	S.	P.	2,683	2,212	82.4	12	2,176,396	68	811
Brockton, Mass.	27,294	Pub.	S.	G.	2,700	1,676	60.2	10.1	.....	.....	.....
Newton, Mass.	24,379	Pub.	S.	P.	4,440	2,995	67.4	5.5	985,396	40	224
Joliet, Ill.[27]	23,264	Pub.	S., U.	P.	365	365	100	.....	1,747,134	75	.....
Lexington, Ky.	21,567	Co.	S.	P.	936	558	59.2	26.7	800,000	37	963
Woonsocket, R. I.	20,830	Pub.	S.	P.	1,117	924	82.7	18.7	328,455	16	292
Bayonne, N. J.[28]	19,033	Pub.	[28]	[28]	870	1,100	.....	.....	.....	.....	.....
Columbus, Ga.	17,303	Co.	S.	G.	818	722	88.3	21.1	.....	.....	.....
San Diego, Cal.[29]	16,159	Co.	L.	G.	2,394	1,252	52.3	6.8	651,286	40	272
Alameda, Cal.[30]	11,165	Co.	U.	P.	1,600	1,600	100	.....	.....	.....	.....
Jacksonville, Ill.	10,740	Pub.	S., U.	P.	550	290	52.7	19.5	500,000	47	909
El Paso, Tex.	10,338	Co.	S.	P.	800	450	56.3	12.9	600,000	58	750
Laconia & L. V., N. H.[31]	9,140	Co.	L.	P.	918	500	54.5	9.9	317,739	35	346
Flushing, N. Y.	8,436	Pub.	U.	P.	1,297	675	52	6.5	512,000	61	395
Paris, Tex.	8,254	Co.	U.	G.	196	121	61.7	42.1	150,000	18	765
New Rochelle, N. Y.	8,217	Co.	S.	P.	608	560	92.1	13.5	130,000	16	213
Winston, N. C.	8,018	Co.	U.	P.	155	100	64.5	51.7	150,000	19	968
Westerly, R. I.	6,813	Co.	S.	P.	380	225	59.2	17.9	203,000	30	534
Gainesville, Tex.	6,594	Co.	S.	P.	309	202	54.8	17.9	.....	.....	.....
Pasadena, Cal.[32]	4,882	Co.	S.	G.	300	300	100	.....	150,000	.....	500
Tarrytown, N. Y.	3,562	Pub.	S.	P.	300	300	100	11.8	.....	.....	.....
Princeton, N. J.	3,472	Co.	S.	P.	288	265	92	11.9	65,000	19	226
Salem, N. C.	2,771	Co.	S., U.	P.	124	105	84.7	22.4	.....	.....	.....
Clyde, N. Y.	2,688	Co.	S.	P.	70	38	54.3	38.4	40,000	15	572
Irvington, N. Y.[33]	2,290	Pub.	S., U.	P.	100	100	100	.....	15,000	7	.....
Bridgeport, Ala.	1,000 est.	Co.	S.	G.	40	25	62.5	25	.....	.....	.....
Wakefield, R. I.	1,000 est.	Co.	S.	P.	200	143	68.4	4.8	75,000	75	359
Union, Md.	743	Co.	S.	P.	110	115	.....	6.8	40,000	54	364
Green River, Wyo.	723	Co.	S.	P.	310	190	61.3	2.3	500,000	692	1,613

* Populations are according to the 1890 census, except in two instances near the foot of the second part of the table. They are for the whole city, regardless of the proportion of the population supplied. When outside populations are supplied the total populations of all cities and towns supplied is given in parenthesis at the right.

† Sources of supply are divided into three classes, lakes, streams and underground, denoted by L., S. and U., respectively. Lakes are designed to include supplies from all bodies of water not artificial; streams, all supplies from springs, running and surface water, and from artificial ponds; and underground, supplies from wells of all kinds or from filter galleries. Modes of supply are divided simply into gravity and pumping.

[1] Chicago. Figures are for main city works. Estimated populations supplied by small public plant built by former village of Washington Heights and of former village of Pullman, supplied by a company, are excluded. Number of taps is unknown but must be at least 170,000.

[2] Philadelphia. Estimated populations of Holmesburg and Tacony, supplied by companies, are excluded.

[3] Brooklyn. Long Island Water Supply Co. supplies 26th Ward. Figures for city are first given, then those for company. Total population, 806,343.

[4] St. Louis. Figures are for year closing Apr. 9, 1890, as these are nearer census population. Consumption for succeeding year was: Total average daily, 36,001,000; per capita, 80; per tap, 871.

[5] Boston. Supplies Somerville, with population of 40,152; Chelsea, 27,909; Everett, 11,068. About 65% of total supply is by gravity.

[6] San Francisco. Figures are for June 30, 1890. Special report made Dec. 16, 1891, gives following figures: Taps, about 35,000; meters, 14,842, or 42.4% of taps; total average daily consumption for calendar year 1891, with estimates for last 16 days of December, 19,372,000 galls.

[7] Cincinnati. Supplies Avondale and Clifton, with populations of 4,473 and 1,2 0, latter estimated.

[8] Cleveland. Supplies Brooklyn and West Cleveland, with populations of 4,585 and 4,117.

[9] New Orleans. In addition to taps given there were, April, '91, 5,880 not in use.

[10] Pittsburg. Monongahela Water Co. supplies "South Side" and outside towns with estimated aggregate population of 75,000.

[11] Washington. Figures are for July 1, 1891, and population is for the whole District of Columbia, the government of which and of Washington is now coextensive.

[12] Newark. Supplies Belleville, through meter, population of which is 3,487.

[13] Jersey City. Figures are for 1889. Supplies Bayonne, population of 19,03; Harrison, 8,338, and Kearney, 7,064. All towns supplied by meter measure, and Bayonne has large percentage of taps metered, all of which reduces consumption for Jersey City. *Report did not state* whether total average daily consumption includes supply to above places, but it is assumed that it did.

[14] Louisville. City owns practically all of company's stock.

[15] Omaha. Supplies South Omaha; population, 8,026.

[16] Rochester. Domestic supply by gravity from lakes; remainder by direct pumping from river.

[17] Kansas City. Supplies Kansas City, Kan., with population of 38,316.

[18] Providence. Supplies population in adjacent towns, estimated at 10,000, which estimate is low rather than high.

[19] Albany. Taps and meters are for December, 1891.

[20] Syracuse. Figures are for December, 1891, and are approximate.

[21] Nashville. Meters, Dec. 29, 1891, had increased to 172.

[22] Grand Rapids. Company figures, first line, are for 1889.

[23] Camden. Taps are for 1888.

[24] Trenton. Taps approximate. Meters for 1887.

[25] Hoboken. Supplies 11 outside towns with combined population of 43,515.

[26] Pawtucket. Supplies several outside towns with population estimated as 23,667.

[27] Joliet. Taps and meters for 1886.

[28] Bayonne, N. J., and Union, Md. Taps and meters are probably unmetered and metered taps, respectively, since reports give more meters than taps.

[29] San Diego. Works are now leased and operated by the city.

[30] Alameda. Supplies Fitchburg, of unknown population.

[31] Laconia and Lake Village Population estimated.

[32] Pasadena. North Pasadena Land & Water Co.

[33] Irvington. Taps and meters for 1887.

worse, reduce their consumption by the use of meters and thus lessen their outlay for pumping machinery, new and larger mains, and other appurtenances, and thus lesser in turn the fixed and current expenses of the works?

While the field for the introduction of meters is very large, yet advance has been made in the last three years, as is shown in some detail below. This advance is due to the growing enlightenment of the people on the subject, which has been furthered by the experience of cities where meters have been largely used with excellent results and through the educational work done by the American and New England Water-Works Associations at their conventions and in their publications, and, it may be added, by the technical journals.

The figures relating to taps and meters given three years ago in the first issue of the "Manual" may be compared with those in the present volume. The number of taps and meters reported in the 1888 and the 1891 "Manuals," the increase and increase per cent. and the per cent. of taps metered, as reported in the two volumes for the several groups of states and for the whole country, is as follows:

	Taps. 1888.	1891.	Increase.	Increase, per cent.
N. E.	315,404	361,651	46,247	14.6
Mid.	890,021	921,748	31,727	3.6
S. Atl.	48,334	62,212	12,878	26 6
S. Cent.	50,302	63,413	13,111	26.1
N. Cent.	352,463	474,234	121,771	34.6
N. W.	55,538	88,476	32,938	59.3
S. W.	89,756	125,356	45,600	50.8
Pac.	87,936	115,823	27,897	31.7
U. S	1,889,744	2,212,913	323,169	17.1
Canada	172,947	183,849	10,902	.....

	Meters. 1888.	1891.	Inc.	Inc. per cent.	Per cent. of taps metered. 1888	1891.
N. E.	37,913	50,938	13,025	34.3	12.	14.1
Mid.	34,346	50,417	16,071	46.7	3.9	5 5
S. Atl.	2,889	5,088	2,199	76.1	6.	8.2
S. Cent.	2,365	3,425	1,060	44.8	4.7	5.4
N. Cent	12,685	21,183	9,098	75.3	3.4	4.5
N. W.	3,447	6,840	3,467	98.8	6.2	7.7
S. W.	4,425	8,163	3,738	84.5	4.1	6 c
Pac.	9,945	17,124	7,179	72.2	11 3	14.8
U. S	107,415	163,178	55,763	51.9	5.7	7.4
Canada.	2,077	3,198	1,121	54.	1.2	1.7

The last two columns are of special interest, showthat in each group there has been in the past three years an increase in the percentage of taps metered, the Pacific group having increased from 11.3 to 14 8 per cent., and the United States from 5.7 to 7.4 per cent., a gain of 1.7 per cent., or about one-third in the three years.

In numbers the meters have increased 51.9 per cent. in the United States, or from 107,415 to 163,178, against an increase of but 17.1 per cent. in number of taps, or in other words the number of meters has increased at a rate three times as fast as the taps, which agrees with figures given at the close of the last paragraph. In the Northwestern group the number of meters has nearly doubled in the three years, the percentage of increase being 98.8, but the original number was only 3,447. Other details may be seen by referring to the table.

Passing from the use of meters alone to their effect upon consumption, reference may be made to Table 8-S for facts relating to the 50 largest cities of the United States and to all cities of smaller size hav-

ing more than 50 per cent. of their taps metered. This table shows the population of the several cities; the population on works (not the actual population supplied, but the population of the city in question and other towns supplied by it); the ownership of the works, whether by the public or by a company; the source and mode of supply, number of taps and meters and per cent. of taps metered, together with the population per tap; and under daily consumption the total amount, amount per inhabitant and per tap.

Attention is called to the fact that the populations and average daily consumptions correspond as nearly as possible in point of time, the 1890 census having been taken in June and the consumption being the average for the whole year. Some of the fiscal years do not correspond exactly with the calendar years, but with two or three exceptions, indicated in the foot notes, there is not much divergence in this particular.

Unfortunately the population actually supplied by each works cannot be given, as only the total population is known. To supply this lack so far as possible the population per tap has been included for the several works. While this is far from being an absolute guide as to the relative proportion of population supplied, it helps materially in understanding many of the figures for consumption per inhabitant. For instance, New Orleans has the very low daily consumption of 37 gallons and but 0.4 per cent. of its taps metered. But it also has a population of 54 per tap, four times as great as New York with its dense population.

Some of the figures under average daily consumption are evidently estimated, and that not very closely, as they are given in millions of gallons. All figures, however, are included as reported. The percentage of taps metered, of course, is more satisfactory than some of the other figures, as the exact number of service connections can always be known and, it is believed, has generally been given.

The above general remarks, together with the foot notes to the table, will enable the reader to form an opinion regarding the value of all figures given. The figures are the best that can be obtained, and are more complete, uniform and more nearly up to date, it is believed, than any ever before published. They give certain facts regarding the consumption of water and use of meters in the 50 largest cities of the United States and in others both large and small which, although they must be taken with qualifications, are for comparative purposes of great general value and are unsurpassed as relating to the several cities in question.

Aside from its value as a convenient reference table the figures above are of chief use in connection with a study of the effect of meters upon the consumption of water. It is true that they do not show what has been done in any of the cities in question by means of inspection of fixtures and other measures to prevent waste, but the use of meters alone has a sufficient effect upon consumption to warrant a study from which all other waste preventing factors are eliminated. To facilitate this study the 50 largest cities, those in the first part of Table 8-S which are there arranged by size, have been rearranged first in order of consumption, greatest to least, and then in order of percentage of taps metered. The latter arrangement is placed beside the former and the order reversed from least to greatest, in order that it may be seen how nearly consumptions and meter percentages correspond. The percentage of taps metered is given in connection with the first and the consumption with the last arrangement, and with each the population per tap is included, as well as the rank of the city in size and also in the classification under immediate consideration. The figures are given in Table 8½-S.

It will be seen from the table that Allegheny has the highest consumption and that it has no meters. It will also be seen that all the places with a high consumption have but a few meters, none of the 17 highest on the list having more than 4.1 per cent. of their taps metered, and Milwaukee being the only city with a consumption of more than 100 gallons, which has over 6 per cent. of its taps metered, this percentage at Milwaukee being notably large, 31.9. Glancing down the list it will be seen that as the consumption decreases the percentage of taps metered shows a general increase, until with the two lowest consumptions, 36 and 29, at Atlanta and Fall River, respectively, the percentages of taps metered are 80.6 and 74.6. There are some instances of a low consump-

Table 7—S.

United States and Canadian Water-Works.—Use of Meters by States and Groups of States.

	Number of		P. ct. taps metr'd.	Number of works: Using metrs.	Not using metrs.	Not report-ing.	Total.	P. ct. of wks. rep't'ng metrs.
	Meters.	Taps.						
Maine	362	15,127	2.4	15	14	8	37	40.5
New Hampshire	1,956	17,056	11.5	15	7	14	36	44.7
Vermont	615	9,533	6.4	7	11	6	27	25.9
Massachusetts	31,859	249,499	12.8	92	28	8	128	71.9
Rhode Island	15,036	27,055	55.6	10	1	3	14	71 4
Connecticut	1,110	43,361	2.6	27	14	7	48	56.3
New England	50,938	361,651	14.1	166	78	46	290	57.2
New York	38,469	328,946	11.7	93	72	34	199	47.7
New Jersey	8,546	111,883	7.6	37	14	7	58	63.8
Pennsylvania	2,194	355,309	.6	74	102	40	216	34.3
Delaware	28	13,489	.2	1	4	1	6	16.6
Maryland	1,003	79,551	1.4	12	3	3	18	66.6
District of Columbia	87	35,270	.3	1	0	0	1	100
Middle	50,417	921,748	5.5	218	195	85	498	43.8
Virginia	294	27,382	1.1	12	14	15	41	29.3
West Virginia	6	10,980	.05	3	6	1	10	33.3
North Carolina	495	2,944	16.5	8	3	4	15	57.3
South Carolina	33	1,582	2.1	4	1	2	7	57.1
Georgia	3,806	15,260	24.9	9	5	7	21	42.9
Florida	454	4,055	11.2	6	2	4	12	50
South Atlantic	5,088	62,212	8.2	42	31	33	106	39.6
Alabama	1,304	11,158	11.7	9	7	4	20	45
Mississippi	29	1,550	1.8	3	1	3	7	42.9
Louisiana	39	5,165	.8	3	0	1	4	75
Tennessee	351	17,511	.2	8	2	6	16	50
Kentucky	1,702	28,029	6.1	15	3	5	23	65.2
South Central	3,425	63,413	5.4	38	13	19	70	54.3
Ohio	5,143	127,880	4.2	51	19	16	86	59.3
Indiana	927	17,800	5.2	28	13	9	50	56
Michigan	2,157	83,345	2.6	28	24	61	113	24.7
Illinois	6,121	198,937	3.1	45	13	44	102	44.1
Wisconsin	6,835	46,212	14.8	25	7	18	50	50
North Central	21,183	474,234	4.5	177	76	148	401	44.1
Iowa	2,439	21,086	11.1	32	20	25	77	41.6
Minnesota	1,291	28,759	4.1	13	9	12	34	38.2
Kansas	999	17,910	5.6	33	22	24	79	41.8
Nebraska	1,485	14,266	10.4	18	20	24	62	29.3
South Dakota	78	2,716	2.8	3	12	7	22	13.6
North Dakota	204	1,401	14.5	4	3	0	7	57.1
Wyoming	195	1,598	12.2	3	2	4	9	33 3
Montana	149	2,740	5.5	5	2	4	11	45.4
Northwestern	6,840	88,476	7.7	111	90	100	301	36 8
Missouri	5,524	61,046	9	23	2	11	36	63.9
Arkansas	132	4,369	3	7	5	0	12	58.3
Texas	1,753	33,818	5.2	28	16	16	60	46.7
Colorado	285	21,657	1.1	14	23	20	57	24.6
New Mexico	69	1,426	4.8	3	0	6	9	33.3
Southwestern	8,163	125,356	6.5	75	46	53	174	43.1
Washington	332	7,199	4.6	6	2	30	38	15.6
Oregon	83	11,631	.7	5	11	10	26	19.2
California	16,641	84,081	19.8	36	25	42	103	35
Arizona	55	1,038	5.3	2	0	2	4	50
Nevada	13	5,570	.2	1	3	5	9	11.1
Utah	0	4,634	..	0	4	3	7	0
Idaho	0	1,670	..	0	4	6	10	0
Pacific	17,124	115,823	14.8	50	49	98	197	25.4
Total United States	163,178	2,212,913	7.4	877	578	582	2,037	43.1
Total Canada	3,198	183,849	1.7	32	17	46	95	33.7

TABLE 8½—S.

Table 8—S. Reareanged to Show the Effect of Meters upon Consumption.

Works arranged in order of Consumption, greatest to least. City.						Works arranged in order of Taps metered, least to greatest. City.					
Rank in:			Consumption per inhabitant.	Per cent. taps metered	Population per tap.	Rank in:			Per cent. taps metered	Consumption per inhabitant	Population per tap.
Size.	Consumption.					Size.	Taps metered.				
28	1	Alleghany	238	0	7	28	1	Allegheny	0	238	7
11	2	Buffalo	186	0.2	6.3	49	..	Camden	small	131	....
34	3	Richmond	167	1.4	7.9	36	3	Paterson	small	128	11.8
15	4	Detroit	161	2.1	5.1	50	4	Trenton	small	62	6
14	5	Washington	158	0.3	6.5	13	5	Pittsburg (Co)	small	153	8.2
13	6	Pittsburg (Co.)	153	small	8.2	48	6	Reading	0.1	75	5.8
38	7	Nashville	146	0.8	14.9	7	6	Baltimore	0.1	94	5 8
13	8	Pittsburg(Pub)	144	0.2	....	13	7	Pittsburg (Pub)	0.2	114	....
2	9	Chicago	140	....	....	11	7	Buffalo	0.2	186	6.3
35	10	New Haven	135	....	....	44	7	Wilmington	0.2	113	5.
3	11	Philadelphia	132	0.3	6.1	3	8	Philadelphia	0.3	132	6.1
49	12	Camden	131	small	....	14	8	Washington	0.3	158	6.5
36	13	Paterson	128	small	11.8	12	9	New Orleans	0.4	37	54.
46	14	Troy	125	3.9	10.5	29	9	Albany	0.4	unk'n	6.2
43	15	Memphis	124	3.7	11.9	38	10	Nashville	0.8	146	14.9
44	16	Wilmington	113	0.2	5	26	11	Denver	0.8	....	....
9	17	Cincinnati	112	4.1	8.5	19	12	Jersey City	1.2	97	....
16	18	Milwaukee	110	31.9	11.1	34	13	Richmond	1.4	167	7.9
10	19	Cleveland	103	5.8	8.7	15	14	Detroit	2.1	161	8.7
19	20	Jersey City	97	1.2	....	41	15	Cambridge	2.4	64	6.6
7	21	Baltimore	94	0.1	5.8	17	15	Newark	2.4	76	8.6
21	21	Omaha	94	19.4	24	4	16	Brooklyn	2.5	72	8.7
6	22	Boston	80	5	6.6	43	17	Memphis	3.7	124	11.9
1	23	New York	79	39.2	13.9	45	18	Dayton	3.8	47	20.4
30	24	Columbus	78	6.4	11.5	46	19	Troy	3.9	125	11.5
17	25	Newark	76	2.4	8.6	9	20	Cincinnati	4.1	112	8.6
48	26	Reading	75	0.1	5.8	23	21	St. Paul	4.2	60	12.7
18	26	Minneapolis	75	6.3	16.5	6	22	Boston	5.	80	6.6
20	27	Louisville	74	5.9	11.9	10	23	Cleveland	5.8	103	8.7
33	28	Toledo	72	9.4	18.6	20	24	Louisville	5.9	74	11.9
4	28	Brooklyn	72	2.5	8.7	18	25	Minneapolis	6.3	75	16.5
5	28	St. Louis	72	8.2	11.8	30	26	Columbus	6.4	78	11.5
27	29	Indianapolis	71	7.6	35 6	27	27	Indianapolis	7.6	71	35.6
24	29	Kansas City	71	17.6	15.3	5	28	St. Louis	8.2	72	11.8
31	30	Syracuse	68	14.6	21.5	33	29	Toledo	9.4	72	18.6
37	31	Lowell	66	22.9	9.2	22	30	Rochester	11.4	66	5.4
22	31	Rochester	66	11.4	5.4	47	31	Gr. R'pids(Pub)	12	..	....
41	32	Cambridge	64	2.4	6.6	31	32	Syracuse	14.6	68	21.5
50	33	Trenton	62	small	6	47	33	Gr'd R'pids(Co)	15	..	....
8	34	San Francisco	61	41.4	9.9	24	34	Kansas City	17.6	71	15.3
23	35	St. Paul	60	4.2	12.7	21	35	Omaha	19.4	94	24
32	35	Worcester	59	89.4	8.9	1	36	New York	39.2	79	13.9
25	37	Providence	48	62.4	9.4	37	37	Lowell	22.9	66	9.2
45	38	Dayton	47	3.8	20.1	16	38	Milwaukee	31.9	110	11.1
12	39	New Orleans	37	0.4	54	8	39	San Francisco	41.4	61	9.9
42	40	Atlanta	36	80.6	20	25	40	Providence	62.4	48	9 4
40	41	Fall River	29	74.6	14.9	40	41	Fall River	74.6	29	14.9
47	..	Gra'd Rapids(Co)	..	15	....	32	42	Worcester	89.4	59	8.9
47	..	G'd Rapids (Pub)	..	12	....	42	43	Atlanta	80.6	36	20
39	..	Scranton (2 Co.'s)	..	....	....	35	..	New Haven	....	135	....
29	..	Albany	..	0 4	6.2	39	..	Scranton	....	....	....
26	..	Denver (2 Co.'s)	..	....	....	2	..	Chicago	....	140	....

*Denver City Water Co.

The classification by percentage of taps metered makes clear, from another point of view, the facts already considered, but does not need further comment than has already been made.

tion in connection with a very few meters, the most notable one being New Orleans, with a consumption of only 37 gallons, and with but 0.4 per cent. of its taps metered. This low consumption, however, is apparent rather than real, the population per tap, as noted above, being 54, against 13.9 in New York, which shows that a very large part of the population is not supplied, a statement which is further proven by the fact that there are more taps in the city not in use than in use.

It should be stated before leaving this part of Table 8-S that some of the works in question have a rigid system of inspection of fixtures by which the consumption is reduced, as for instance Boston.

The second part of Table 8-S shows the same facts as are given in the first part for such of the remaining works of the United States as have over 50 per cent. of their taps metered, arranged in order of size. There are 33 such works, and in addition, four of the 50 largest cities come in this class, as follows: Atlanta, 80.6 per cent.; Worcester, 89.4; Fall River, 76.6, and Providence, 62.4 per cent.

No attempt is made to classify works with more than 50 per cent. of taps metered except by size, owing to the wide differences between the several towns and the incompleteness of some of the returns upon which the table is based. It may be said, however, that all the consumptions are low, with the exception of Green River, where, it is believed, a large number of collieries are supplied, besides several railway shops and buildings. None of the other consumptions go above 75 and 12 out of 23 are at or below 30, with six below 20. But these figures are often much too low, owing to the large population not supplied, as shown by the high figures in the population per tap column. In addition some of the total average daily consumptions are probably not even estimates but mere guesses.

TUNNELING IN SOFT GROUND.

It is curious to note what a revolution in engineering has been wrought by the introduction of power drills and high explosives. Before their use tunneling through rock, especially the harder varieties, was a slow, laborious and enormously expensive process. At the present time, tunneling through hard rock, free from seams and faults, can be carried on with such certainty and dispatch that, if we take into account the cost of lining, a tunnel can probably be built far more cheaply through it than through any other material, though the solid rock has always had some slight advantage.

The apparently easy task in tunneling is now more than ever the most difficult. The softest and apparently most easily removed materials now offer by far the greatest obstacles to the engineer. But it appears to be true that a large proportion of our tunnels will, in future, be made through these materials.

In the past tunnels have been chiefly built on railway lines, and the object of their construction has been generally to pass through a dividing ridge, around or over which the road could not economically be carried. Such tunnels have, therefore, as a rule, been made through rock. But in future it seems to be probable that a much larger proportion of the tunnel work will be done within the limits of the large cities. There is a steadily increasing demand in all cities of considerable size, that local rapid transit railways and terminals for ordinary freight and passenger traffic be taken out of the city streets, and either raised above or depressed below their general level, the latter in many cases being the preferable plan. The construction of large size sewers and of subways for the systematic disposal of all sub-surface pipes and electric wires also seems likely to call for the construction of many tunnels under city streets in the near future. Granting this, it appears that as practically all great cities are built on alluvial formations and made ground, tunnels within their limits must generally be made through soft material.

It is safe to say, then, that the proper construction of this class of tunnels forms one of the most important and interesting of engineering problems at the present time. It is rightly called a problem, for not enough has yet been done in this direction on any one system to establish precedents and regulate practice; and if the best method of constructing such a tunnel as that for the proposed New York City Rapid Transit Railway under lower Broadway is presented for discussion, we find leading engineers of large experience expressing diametrically opposite views upon the question.

With a view to giving our readers such information as is available on this important topic, we have taken especial pains to present complete descriptions of every important work of this sort recently undertaken. In Vol. XXIV. we published a series of six articles on the St. Clair tunnel, and we have also given from time to time a great amount of matter descriptive of the City & South London railway and the Hudson River tunnel, both of which works have been carried on by practically the same system as that used at St. Clair.

Still more recently we have given an account of the methods proposed by several prominent engineers for building a tunnel under lower Broadway, New York City, for a rapid transit railway; and we have followed this with descriptions of the system of tunneling in use at the Howard St. tunnel of the Baltimore Belt R. R., of the very different system, involving the use of three hydraulic shields, devised by Maj. Richard Randolph and in use at the York Road tunnel on the same line, and finally we have described the pilot tunnel system of Messrs. Anderson & Barr, now in use for driving a large sewer tunnel in Brooklyn.

The St. Clair tunnel may fairly be said to have established the hydraulic shield system of tunneling as one of the most important and valuable for penetrating soft material. It is true that the method there used (driving forward an iron shield by hydraulic pressure and lining the tunnel with cast iron) had been previously used in the little 8-ft. tunnel under the Thames, built in 1868-9, and in the 10-ft tunnels for the City & South London subway, completed in 1890. But a system which works admirably in running an 8-ft. or 10-ft. drift may fail most disastrously when a tunnel of 20 ft. diameter or more is to be built; and because a tunnel could be built safely through the stiff London clay, it did not follow that one could be built with the same success through the soft and treacherous material under the St. Clair and Detroit rivers. The success of the St. Clair tunnel, therefore, demonstrated that the hydraulic shield system was applicable to large size tunnels, and, if operated with proper precautions, to materials much softer and more treacherous than the London clay. It is safe to say that at the present time subaqueous tunnels through soft materials should invariably be driven with shields. The Chicago and Cleveland water supply tunnels, for example, which extend out under the lake, if built at the present time would be driven with a shield, even if brick were used for the lining. The additional security of the workmen and of the completed work is worth all it costs. In fact, at the present day, the engineer of any tunnel to be driven through quicksand or very treacherous ground will naturally adopt the shield system.

But in building tunnels through the sand, loam, clay and similar loose materials underlying most of our large cities, the problem has come to be, not only to construct the tunnel itself with safety and economy, but to do so without injuring the foundations of adjacent buildings, the pipes and sewers overhead or the pavements in the streets. The question what method of tunnel driving will best secure this end is one which remains to be settled; and it is undeniably the most important one in connection with tunnel construction in our large cities.

The oldest (and some will say the most reliable system of drifting through loose materials is the "poling board" system, which we have recently fully illustrated in connection with the Baltimore Belt Railroad, (Eng. News, Dec. 19, 1891). This tunnel is of very large size, the arch having 27 ft. clean span. The material penetrated is chiefly a sandy clay containing a great deal of water. The English bar method of timbering is in use, and we believe the work is being done by competent men, who use all reasonable care and precautions. So far we are informed that the foundations of buildings along the street have not been injured; but the street pavement has settled, in some places as much as 18 ins., and even more than this, according to one informant. Considerable settlement and cracking has also taken place in the sewers, and water and gas pipes over the tunnel. The fact is that in loose ground, with the ordinary method of working with poling boards and temporary timber supports which are replaced with a brick arch, it seems to be practically impossible to avoid taking out material in excess of the actual bulk of the tunnel and its lining, and thus causing settling above. The compression of the timbering from the weight which it carries, the props having to be changed two or three times, is alone sufficient to cause considerable settling; and even with the greatest care on the part of the miners, some material over the line of the tunnel is apt to work down as the heading advances. Of course with material which will stand fairly well, settlement may be prevented even when ordinary timbering is used. At the Howard St. tunnel no settlement at all has occurred on some parts of the line, where the ground was free from water and fairly stable. But the real test of any system is whether it can prevent settling when drifting through loose, running materials, veins of which are liable to be met in almost any soft ground tunnel. If any engineer has drifted through this sort of material with poling boards and ordinary timbering and has not disturbed the material overhead, we trust he will at once report his experience for the benefit of the readers of Engineering News.

The hydraulic shield system of tunneling has certainly great advantages over the old timbering system as regards the prevention of overhead settlement. As the permanent lining of the tunnel is put in place under protection of the rear of the shield, the settlement at this point will be only that corresponding to the thickness of the shield's shell, an inch or so at most. Even this can be avoided by injecting grout under pressure through the lining, as was done in building the City & South London subway.

The only opportunity for settlement of the material overhead, then, with the shield system of tunneling, is at the front of the shield. Let us consider what has taken place there with the different tunnels built on this system. The 10-ft. tunnels of the City & South London Subway were driven beneath streets and buildings of large size, and in no case were foundations disturbed or street pavements sewers or other surface works injured. But it is important to note that the tunnel was but 10 ft. in diameter and was about 50 ft. below the surface. Further, the material through which it is driven, the stiff London clay, stands so well that tunnels have been made in it beneath large buildings without the use of a shield. One, described in Engineering News, Dec. 20, 1890, passes for 165 ft. under a canal and then under the freight station at King's Cross with the crown of the arch only 6 ft. below the foundations. This tunnel is over 25 ft. in diameter. It was driven by an iron poling board system, similar in principle to that devised by Mr. L. L. Buck for the New York Rapid Transit Railway (Eng. News, Oct. 17, 1891).

As further proof of the excellent nature of the material penetrated in building the City & South London tunnels, it is stated that in advancing the shield it was customary to keep a circular space dug out two or three feet in advance of the shield and of slightly less diameter. As the shield moved forward, it cut away the remaining material and made a passageway in the clay of exactly the right size. Further, at the rear of the shield the clay stood up so well that grout could be forced in between the outside of the lining and the clay roof. Under these conditions, overhead settlement would hardly be expected.

The St. Clair tunnel was also driven through clay, and with a shield of the same general design as that used in the London subway; but it was a much softer clay and could not always be excavated ahead of the shield as described above. At times it was so soft that all the workmen retreated to the rear of the shield and the hydraulic pressure was turned on, forcing the shield into the soft mass, which filled it full and rolled back through the bulkhead doors.

At some points the bulk of the material excavated is stated by Chief Engineer Joseph Hobson to have been as much as 50 per cent. in excess of the space occupied by the tunnel. Considerable depressions of the surface over the line of the tunnel occurred at places where an excess of material was removed. After work began under the river, compressed air was used; and the working face stood up very much better. A 20-ft. seam of gravel was passed through near the Canadian side, and it was only keeping most of the exposed surface of the excavation plastered with clay that prevented all the compressed air from blowing out into the river. Even with these precautions there was an active geyser in the river over the tunnel until the gravel seam was passed.

Of course at the Hudson River tunnel, one heading of which has been driven about half a mile with a hydraulic shield, it is impossible to note settle-

ment of the material over the tunnel, and difficult to tell how much the material removed is in excess of that displaced by the tunnel; but it is well known that it is only by use of compressed air that the semi-liquid material is kept from flowing into the shield. It is probable, indeed, that this is the most difficult piece of soft ground tunnel work ever undertaken; certainly it is far more difficult than would ordinarily be found in tunneling under city streets.

It may be claimed that this is also true of the St. Clair tunnel; but that claim is yet to be proved. From all we can learn, we believe that the soft clay at St. Clair gave no more trouble by running in from overhead at the front of the shield than would be experienced in tunneling through ordinary sand, such as underlies New York and Brooklyn. It is to be remembered that in sand formations compressed air cannot be used to support the working face, or rather has not been used, so far as we are aware. Perhaps it might be used by plastering the working face with clay, as noted above, but the feasibility of this plan when working in dry material remains to be determined.

We know of but one case where a hydraulic shield has been used for tunneling through sand formation beneath city streets. That is the short experimental tunnel built in New York City in 1870 under Broadway near Warren St. Whether the pavement above this tunnel was injured we do not know; but it has been stated that the water mains above the tunnel were badly cracked and had to be renewed. An 8-ft. tunnel was also built with the Beach shield in Cincinnati, a year or two later. We have no information as to the material penetrated or the amount of settlement which occurred.

Summing up, then, the experience with the shield system of tunneling, it must be said that the possibility of working with it in sand or gravel or any unstable ground and preventing all movement of material outside the line of the tunnel is yet to be proved. An idea is prevalent that with the shield system, or, as the newspapers generally call it, the Greathead system, a tunnel may be built through any soft ground without disturbance of the material overhead and that this is the chief characteristic of the system. The fact is that the shield system was devised by Brunel for subaqueous tunneling, its essential idea being the provision of a permanent bulkhead at the face of the work to check any sudden inrush of water or quicksand.

It is true that the shield method of tunneling permits putting the lining in place with very little disturbance of the overlying material; and that the cast-iron lining, which has been generally used with it, is practically unyielding, whereas the brick arch settles considerably at the crown by compression of the mortar joints. It is likely that ways may yet be devised of so supporting unstable ground at the front of the shield that settlement of the overlying material will be practically nil. But this is yet to be tried; and until it is shown that it can be done, the experience with the system in the London clay should not be taken as a precedent for its use in sandy soil where valuable foundations are at stake.

The pilot tunnel system, devised by Mr. John Anderson while engaged in driving the Hudson River tunnel upon the old Haskin plan, enables tunnels to be driven with less overhead settlement than occurs with the ordinary timbering system. We described this method when first put into use (Eng. News, June 18, 1881), and recently (Jan. 2) as applied to the tunnel for the Brooklyn intercepting sewer. The report of Mr. L. Russell Clapp to City Engineer Van Buren, of Brooklyn, gives the following concerning overhead settlement with this system:

> The top plates of the shell are first placed in position, the material being excavated in advance and supported temporarily by light poling boards. . . . The excavation follows so closely to the outer lines of the normal section of the tunnel that very little loss occurs, even in bad material, and there is no loss where sufficient bond exists in the material to hold it in place until the poling boards are in position and there is less demand for packing outside of the tunnel lining than would be required by other methods of tunneling. Exceptional safety to neighboring property is assured by this method.

It is noticeable that in this system and also in the hydraulic shield in use at the York Road tunnel of the Baltimore Belt R. R., described last week, ordinary poling boards are used at the head of the drift. In fact, it is self-evident that the poling board or some other support is necessary if a tunnel is to be built through running ground without disturbing material overhead. The poling board principle is simply that a thin plate of some sort must be forced into the ground to furnish support to the material overhead when that underneath is removed. This is really the essence of the tunneling system proposed for the New York Rapid Transit tunnel by Mr. L. L. Buck. The same end might perhaps be reached with the hydraulic shield system, by making the top of the cutting edge project farther to the front and keeping it all the time ahead of the excavation. The trouble with this, as with Mr. Buck's plan, would occur when the advancing plate struck a boulder; and on the whole the plan of using common poling boards in advance of a shield when drifting through running ground seems to have as much promise of success as any. The work might even be facilitated by the use of a portable hydraulic ram to drive them.

Aside from the poling board principle the only feasible plan of tunneling through running ground without causing settlement is to "doctor" the ground ahead of the excavation, so that it will support itself. Mr. John Anderson has done that very successfully when working in dry running sand by wetting the ground ahead of the work. On the other hand, at the Howard St. tunnel of the Baltimore Belt R. R., driven wells are put down ahead of the work to "bleed" the ground, and have greatly increased its stability in the drifts.

It has also been proposed to use the Poetsch freezing process for especially difficult tunneling, and we see no difficulty in so doing. The expense, we believe, is considerable; but in safely carrying through a difficult section of an important work its expense would be of little importance. It is probable, indeed, that softer ground could be penetrated better with this than with any other system. No shield or poling board system yet devised will enable a tunnel to be made through a liquid, even with the aid of compressed air; but since the freezing process transforms the most fluid quicksand or soil to an adamantine solid, it appears to have an especial merit for the most difficult class of work.

An entirely new system of tunneling through all kinds of soft material, from quicksand up, has recently been devised, and will be described in these columns shortly, as soon as some pending tests (which have so far shown most gratifying results) have been completed. We are disposed to look upon it as a process of much promise, which may easily prove to accomplish all that the freezing process can, much more cheaply and quickly, while also suitable for use under many conditions to which the freezing process is not adapted.

It is possible that in dry sand or gravel the injection of grout ahead of the work and outside the line of the tunnel would make a self-supporting roof. Similar uses of grout have been made in foundations, and experiments in this direction would certainly be of interest. The question of expense, difficulty and delay, however, would make this, like the freezing process, advisable only in exceptional cases. For all ordinary work some mechanical support on the poling board principle must be furnished.

It thus appears that in soft ground tunneling, as in other lines of engineering work, there is no one system which is best for all materials and all circumstances. The experience of the past has developed several systems, each of which has its especial merits, and none of which can penetrate the worst materials under all circumstances without more or less danger and uncertainty. As the records of experience in this work increase, it is to be expected that practice will become more uniform and that work will be carried on with greater certainty. At present it must be said that an engineer engaged in this class of work has an excellent chance to improve over the practice of his predecessors, together with the usual chances of failure which attend upon every attempt to substitute the new and untried for that which has been proved by experience.

Cork street pavement is being tested in London. It is composed of granulated cork and bitumen, pressed into blocks and laid like wood pavement. The special advantages claimed are its elasticity, noiselessness and the affording of a perfect foothold for horses. Its wearing qualities have got to be tested. The pavement is laid by the Patent Cork Pavement Co., of 7 Great St. Helens St., London.

LETTERS TO THE EDITOR.

THE DAY TENSION FRAME.

Sir: I would be obliged to your correspondent W. H. B. if he would give particulars of the highway bridge to which he alludes. It is to be hoped that the designers of the Day railway will take warning by W. H. B.'s somewhat sick looking diagram. I may have the pleasure of warning them again shortly, when the detailed plans of the Day system are published. Yours truly

Chicago, Jan. 4, 1892. T. Graham Gribble.

EFFECTS OF PUNCHING ON SOFT STEEL AND WROUGHT IRON.

Sir: I have read with much interest the first two instalments of Mr. Henning's papers giving the experiments and conclusions of German engineers on the use of steel. These papers are undoubtedly very valuable contributions, and with their general trend I am heartily in sympathy, believing soft steel to be better for many purposes than wrought iron.

But I desire to call attention to the fact that these experiments and tests were all made with comparatively light sections, none of the material, so far as I can judge, reaching ½-in. thickness.

Now a series of tests which I have recently made on the effects of punching on steel and iron (a full report of which will shortly appear in the "Proceedings of the Engineers' Club of Philadelphia"), shows very clearly, I think, that the injurious effects of punching are much more apparent in steel of heavy section than in light material. Up to ½ in. thickness, which is the range of the German tests, the results of these tests are entirely favorable to soft steel in comparison with wrought iron, just as the German results are. But when it comes to ⅝-in. and ¾ in. metal, the injury to the steel becomes quite evident; on the other hand, iron does not seem to be affected in the same way, but is nearly constant for all thicknesses.

There can be no doubt, I think, that this is the fact, although the softer the steel, the less these effects are likely to be. I am disposed to think, however, that in drawing general conclusions from a series of tests made entirely with light sections, the European engineers have been hasty. Yours respectfully, F. H. Lewis.

CANADIAN NOTES.

Sir: Railway and other works have not been carried on in Canada during the year past with the vigor of former years. Public works were almost stopped. The long session of Parliament, the scandals and general uncertainty, did not seem to warrant the Government in voting many subsidies to the many applicants.

This country is undergoing a great crisis; it is under a cloud; there is too much of the spirit of party dominating its public men. Notwithstanding its immense resources of land and sea, forests, mines, fisheries, great harvest of last year and rapid development, Canada is languishing, and will continue to do so until it decides to purge itself of a certain class among its public men. The present indications are that the people are awakening to this fact and will take early steps to clear and purify the political atmosphere. Quebec is now going through the throes of a general election, and honest people are struggling to get rid of boodlers, go-betweens and toll takers. There are some 50 seats vacant, and that number of elections taking place for the Dominion House of Commons. These bye elections are caused by the M. P.'s being unseated for irregularities, etc. There are too many men in the Parliaments connected with railway schemes; and it is claimed as a fact that a bill can scarcely be passed without some of these men having a hand in its control. This is a gross and flagrant abuse of parliamentary privilege, and the abuse should be suppressed. Then, and not till then, will capital seek Canada, and revive and develop its flagging industries.

The Canadian Government have endeavored by every means to get increased markets in Europe, in the British Empire, West Indies and other parts of the world, to restore the exports of Canada which have been injured by the McKinley bill.

The traffic earnings of the Grand Trunk Ry. show an encouraging increase for the past month.

It is reported that the Canadian Pacific Ry. has leased the Kingston & Pembroke Ry. Construction on this end of the Great Northern will be continued in the spring. The Canadian Pacific Ry. is also operating the Montreal & Ottawa from Vaudreil; the line is open to Rigaud, and large gangs at work.

Applications are to be made to Parliament for a railway from the Intercolonial to Louisbourg and Sydney, and for a railway from Spencer Bridge, B. C., to Fort Sheppard. The Government of Quebec is about to pay over the railway subsidies issued during the past season.

Kingston is agitating for an electric street railway, and Pembroke has rejected water-works on a popular vote.

There are at present 3,500 men engaged in mining and lumbering within 20 miles of Sudbury. Lumbering in Quebec and Ontario is at a standstill, owing to the mild and snowless winter. For 48 years the like has not been experienced in Quebec.

A syndicate has been formed by Mr. B. B. Osler to construct and operate a line of electric railway between Fort Erie and Niagara, and to put on the lake route between Niagara and Toronto two fine and fast steel steamers. In this syndicate are several well known Canadian Pacific capitalists, who never yet put their hands to anything without making it a success. The key of the situation is held by the Ontario Government on account of its control of the shore of the Niagara River for a long distance below and above the Falls. For a monopoly privilege of carrying passengers by electric road through the park, the new company has agreed to pay a certain sum per annum for the maintenance of this beautiful summer resort, a source of revenue very much needed; and if they take up the scheme of an electric road between the Falls and Queenstown, along the edge of the rapids and the whirlpool, they will pay an additional annual sum. This scheme would seriously interfere with the tourist traffic of both the Michigan Central and New York Central. It is the intention of the syndicate to put on fine river steamers from Chippewa to Buffalo, and passengers will prefer this route to any other that can be planned. It is expected that the time from Toronto to Niagara will be cut down to one hour and a half, and that the time to Buffalo will be no longer than it now is, or not quite so long, the passengers having a chance to skirt the river all the way from the mouth to Chippewa and Buffalo. Mr. W. T. Jennings has been commissioned to look thoroughly into the working of electric motors, and to report the best available one for adoption. No more competent expert could have been chosen.

The total mileage of the Canadian Pacific Ry. is now 5,678 miles. Its earnings have been most satisfactory, and its expenses small owing to the favorable weather. Hence the returns for the last 10 days of the year show an increase of $146,000 over the same time in 1890. The gross earnings are about $20,203,000, and the net earnings $8,000,000, and this will pay 5% on the common stock.

Montreal, P. Q., Jan. 7, 1891. W.

THE INTERSTATE COMMERCE COMMISSION'S STATISTICAL REPORT.

From advance sheets of the third annual report of the Statistician to the Interstate Commerce Commission, Prof. Henry C. Adams, we take the following matter of especial interest. The report is dated April 1, 1891, and is for the year ending June 30, 1890.

Railway Mileage.—The total mileage of main track in the United States on June 30, 1890, is given as 163,597 miles, of which the Commission received direct returns from all but 4,325 miles. The net increase in mileage over that included in the previous report was 5,838 miles. This, however, does not show all the new construction. Thus, 62.75 miles of street railway track erroneously included in last year's report have been omitted from this, and no less than 152.18 miles of track have been abandoned. Upon 81 miles of this the track has been taken up. Straightening of track and corrections of returns by the railways also cause changes in the mileage.

An interesting table of railway mileage by states and territories shows that Illinois is far in the lead of all the states, having 10,214 miles, 6.24% of the total mileage of the United States. Four other states, Kansas, Texas, Pennsylvania and Iowa, have each between 8,000 and 9,000 miles. Then come Ohio, New York and Michigan, each with over 7,000 miles. In proportion of mileage to territory, Oklahoma is at the foot with 170 square miles for every mile of railway. Nevada, Arizona and Wyoming have over 100 miles. At the other extreme stands Massachusetts with 3.73 square miles per mile of railway. Pennsylvania and Ohio have each 5.44, Indiana has 5.66, and Illinois, 5.43. No other large states approach these four in their proportion of railway mileage to area.

The length of second, third and fourth tracks and of yard sidings and spurs in each of the several groups is given in Table I. The territory covered by each group is explained in another column. It appears that of 156,404 miles of railway in the country only a little over 8,400 is double track, and 5,000 miles of this is in the Middle States. The remaining 3,000 miles is about equally divided between New England, the Central Northern, and the Northwestern groups. Practically all the rest of the country has nothing but single track roads. The third and fourth trackage is nearly all in the Middle States. A very good index of the relative extent of the traffic in each section is the excess of the total trackage, including sidings, over the main track mileage. In the Middle States the additional tracks of all sorts make a mileage nearly 80% as large as that of all main tracks.

Table II. Rolling Stock per 100 Miles of Line, and Service of Rolling Stock in each Group of States.

	Locomotives. Pass.	Locomotives. Frt.	Locomotives. Total.	Cars. Pass. service.	Cars. Frt. service.	Cars. Total.	Service p'rf'm'd per annum by each: Pass. Locomotive. Pass'rs carried (1 = 1,000)	Pass. Locomotive. Pass. miles. (1 = 1,000)	Frt Locomotive. Tons frt. carried (1 = 1,000)	Frt Locomotive. Ton miles. (1 = 1,000)	Pass. cars per 1,000,000 pass'rs carried.	Frt. cars per 1,000,000 tons of frt.
I. New Eng.	13	11	28	46	622	796	118	1,853	52	3,600	31	1.215
II. Middle	13	25	46	46	1,669	2 294	86	1,446	55	5,322	52	1,3 0
III. Cent. No'n	6	13	24	18	833	1,192	45	1,389	50	6,040	65	1.437
IV. So. Atl.	4	7	13	11	316	425	32	1 214	26	4,683	94	1.628
V. Ky., Tenn. & Gulf.	4	7	14	12	390	459	32	1,176	39	4,142	94	1,370
VI. Northwest.	4	8	15	11	473	535	44	1,408	30	4,622	68	2,003
VII. Rocky Mtn.	4	5	12	8	272	344	14	1,092	31	5,178	133	1,715
VIII. Cent. W'n	4	7	12	9	301	381	19	966	21	3,537	119	2,128
IX. Southwest.	2	7	11	8	267	320	24	1,396	16	2,490	140	2.431
X. Pacific	3	8	13	14	203	307	67	2,243	19	2,271	70	2,672
United States.	5	10	19	17	584	744	59	1,413	39	4,722	54	1.529

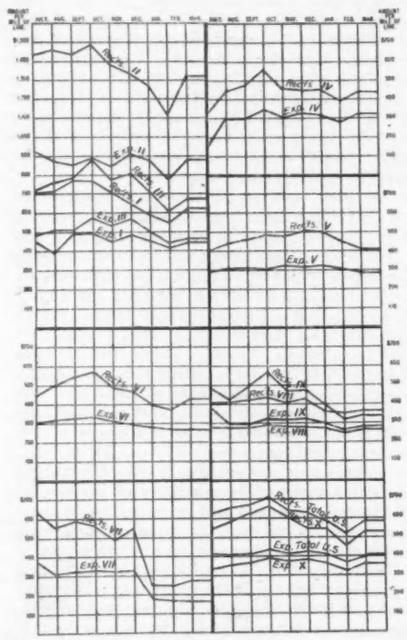


Diagram Showing Monthly Receipts and Operating Expenses of Railways of the United States, by Groups, for Nine Months Ending March 31, 1891

Subdivisions of the United States Adopted by the Interstate Commerce Commission's Statistician.

Table I.—Single, Double, Triple and Quadruple Trackage, and Spurs and Sidings in Each Group.

Group.	Trackage (miles) 1st.	2d.	3d.	4th.	Sidings and Spurs.	Total.
I. New England	7,496	1,248	39	19	2,399	11,121
II. Middle	17,237	4,949	664	507	7,533	30,890
III. Central Northern	20,904	1,048	12	3	6,179	28,146
IV. South Atlantic	8,638	26	...	...	1,116	9,800
V. Kentucky, Tennessee & Gulf	15,877	4	...	...	2,149	18,031
VI. Northwest	38 198	1,012	54	32	7,594	46,889
VII. Rocky Mountain	8,807	14	...	...	1,307	10.127
VIII. Central Western	21,173	93	2	1	3.111	24,381
IX. Southwest	7,989	.....	...	...	936	8,935
X. Pacific	10,136	45	....	...	1,387	11 568
Total. United States	156,404	8,438	761	562	33,711	190,876

Table II. shows the amount of equipment per 100 miles of line in each territorial division and also the average amount of service which is got out of each kind of rolling stock in each group.

Organization of Property for Operation.—There are 1,797 railways having a separate legal existence, and the road of all but 48 of them was operated during the year. Of these corporations, however, only 747 are independent operating companies, the remainder being for the most part companies which have leased their roads or by some other arrangement have put the operation of their property into other hands. But of these operating corporations a few control the bulk of the mileage. Forty roads now operate each over 1,000 miles of road or a total of 77,873 miles, 47% of the total. In 1890 there were only 33 companies controlling over 1,000 miles of line, and their combined extent was 76,963 miles.

An exceedingly interesting table shows the revenue and density of traffic of all railways in each group whose gross revenue exceeded $3,000,000. The New York, New Haven & Hartford heads the list in density of passenger traffic with 618,345 passenger miles per mile of line; and the Pennsylvania lines east of Pittsburg and Erie hold the same position in freight traffic, having carried 2,774,056 ton miles per mile of road during the year. The average freight train load in the whole country is given as 175.12 tons. The Pennsylvania traffic is equivalent to an average of over 40 such train loads every day moved over every mile of its road. It is needless to say that the average freight train load on the Pennsylvania is very much more than 175 tons. Indeed the average for the middle group of states is given as 212 tons. Making a similar comparison for the New York, New Haven & Hartford, we find that its passenger traffic is equivalent to a movement of over 40 trains daily over each mile of road, with an average load of 41 passengers (the average for the United States). The average number of passengers carried per train in New England is 62.

Rolling Stock.—The totals reported are 29,928 locomotives, 26,511 passenger cars in passenger service and 1,137,677 cars of all other classes. This, however, does not include the Pullman and Wagner cars, nor the freight cars owned by private parties, except those that are leased to railway companies. Private owners of cars do not report to the Commission, but it is urged that they should be required to do so in order to make its statistics complete.

Of the locomotives there are 8,384 passenger, 16,140 freight, 4,062 switching and 1,342 unclassified and leased. The increase over the previous year's report is 892, which gives only 15 locomotives for every 100 miles of line in operation. This is less than the average of the whole country, which is 19 locomotives per 100 miles of line. The increase in cars is 95,633. This gives 1,648 cars per 100 miles of new line built, whereas the average for the whole country is only 744 cars of all classes per 100 miles. Table II. shows the amount of equipment per 100 miles of line in each territorial division and also the average amount of service which is got out of each kind of rolling stock in each group.

Automatic Brakes and Couplers.—The statistics on this point are of course too ancient now to be of much more than historical interest, and they seem moreover to have been collected with little or no knowledge of the work done by the Master Car Builders' Association in adopting a standard type of automatic coupler.

Table III., which shows the total rolling stock equipped with train brakes, is, however, worth some attention. One wonders where the 194 passenger locomotives and 1,181 passenger cars unequipped with train brakes are located. The number of freight and passenger locomotives equipped with train brakes is, however, very encouraging. But from another table, giving the brakes of each make in use, it appears that a good many driver brakes are included in the list. The number of freight cars equipped with Westinghouse brakes has apparently been very accurately determined by the statistician, except that the figures omit several thousand cars owned by private companies, over which the commission has no jurisdiction. Our own statistics showed 97,254 freight cars equipped in December, 1889, and 152,390 on Jan. 1, 1891. These

Table III.—Rolling Stock Equipped with Train Brakes on June 30, 1890.

	Total June 30, '90.	Incr. over 1889.	Total unequipped.
Pass. locomotives	8,190	484	194
Frt. "	9,528	785	6,612
Switch "	1,838	472	2,224
Unclassified locomotives	606	426	736
Total	20,162	2,167	9,766
Pass. service cars	25,330	1,790	1,181
All other cars	102,911	16,287	1,034,766

statistics show 102,911 freight cars fitted with train brakes on June 30, 1890.

The total number of each kind of brake in use on all classes of rolling stock is given as follows: American steam, 1,762; Baldwin, 12; Boyden, 86; Eames vacuum, 1,578; Lansberg, 6; Longbridge, 1,111; Salisbury steam, 8; Standard Empire vacuum, 18; Westinghouse, 143,661; not given, 610.

Less credit can be given for the statistics of automatic couplers in the form in which they are presented. They show 955 locomotives, 25,551 passenger service cars and 88,813 cars of other classes fitted with automatic couplers. There was an increase of 645 in the number of passenger locomotive fitted with automatic couplers during the year. Table IV. shows the number of cars equipped with each type of automatic couplers on June 30, 1890, and

Table IV.—Rolling Stock Equipped with Automatic Couplers, June 30, 1890, and 1889.

Coupler.	Cars equipped. 1890.	1889.
M. C. B. couplers:		
Dowling	2,021	921
Fox	3	....
Gould	10,807	952
Hinson	1,900	9
Janney	36,615	17,536
Keystone	10	....
"M. C. B."	10,756	2,677
Schroyer	18	12
Standard	356	....
Tnurmond	3,041	177
Timms	750	6
Van Dorston	2	....
Total	66,279	22,290
Link and pin, etc.:		
Aikman	264	256
Almy	....	126
Ames	1,413	11,808
Blackstone	132	149
Blocker	1,379	3,808
Colby	92	11
Cook	....	3
Cowell	171	61
Hein	212	275
Hilliard	2	1
Huselton	1,342	2,559
Kling	14	10
Lancaster	....	3
Lorraine	10	....
McCree	313	230
McKeen	194	1,525
Marks	1,963	4,162
Mills	1,057	550
Perry	9	440
Phillips	22	26
Runkle	....	2
Safford	1,981	1,729
Skinner	10	12
Smillie	5,440	9,413
Smith	....	404
Sweet	....	3
United States	418	425
Whittemore	84	85
Wilson	....	3
Wilson Blocker	51	52
Total	25,556	38,241
Passenger couplers:		
Miller	19,879	18,941
Janney-Miller	68	30
Total	19,947	18,971
Kind not given	3,537	1,008

on the same date in 1889. We have rearranged this, putting the couplers of the M. C. B. type by themselves, and also the Miller and Janney-Miller, practically all of which are on passenger cars or locomotives. The most significant fact in these tables is that the automatic link-and-pin couplers are gradually dropping out of use, showing a combined decrease in the year of about 13,000 cars, whereas the cars fitted with M. C. B. type couplers increased about 44,000, including couplers of this type on passenger cars. Of course this is really all ancient history. The number of freight cars fitted with the M. C. B. type couplers at the present time will vary little either way from 200,000, according to our best information. The number of new cars now under contract will very largely increase even these figures.

Employees.—The total number of men employed by the railway companies of the United States for the year ending June 30, 1890, was 749,301, an increase over the number employed the previous year

Table V.—Number of Each Class of Employees per 100 Miles of Railway in Each Group of States.

	I. New Eng.	II. Middle.	III. Cen. No'n.	IV. So. Atl.	V. Ky. to Gulf.	VI. No. West.	VII. R'ky Mtn.	VIII. Cen. W'n.	IX. So. West.	X. Pac ific.	Av. U. S.	Av. U. S. 1889.
General officers	7	7	4	3	3	2	2	2	2	2	3	3
General office clerks	17	30	16	9	10	12	13	12	12	10	14	13
Station agents	29	30	20	15	15	15	12	11	8	7	16	16
Other stationmen	93	105	61	30	34	28	14	21	27	22	43	38
Enginemen	33	50	27	16	16	16	15	15	12	10	21	20
Firemen	35	51	28	18	18	17	17	15	12	11	22	21
Conductors	27	35	20	10	11	12	12	9	8	7	15	14
Other trainmen	77	120	48	34	27	25	15	20	17	15	40	36
Machinists	26	52	20	10	12	13	10	11	13	6	18	16
Carpenters	44	59	25	16	22	18	24	12	23	12	24	22
Other shopmen	44	118	66	31	43	48	44	31	25	32	52	49
Section foremen	24	25	20	14	14	18	19	14	14	10	17	17
Other trackmen	125	201	105	88	102	74	74	81	92	77	101	95
Switch, flag, and watchmen	48	69	34	13	17	17	11	10	10	6	24	21
Tel. oper's and train dispch'rs.	10	30	17	11	7	10	8	8	7	4	12	11
On floating equipment	2	12	2	9	6	1	..	4	1	5	4	4
All other	75	173	68	52	29	33	38	31	22	14	53	463
Total	716	1,167	576	379	386	359	328	307	303	250	479	450
Av. length of a track section, miles	4.2	4.0	5.0	7.1	7.1	5.5	5.3	7.1	7.1	10	5.9	5.9
Av. No. of men in section gang	6.2	9.0	6.2	6.3	8.3	5.1	4.9	6.8	7.6	8.7	7.0	6.6

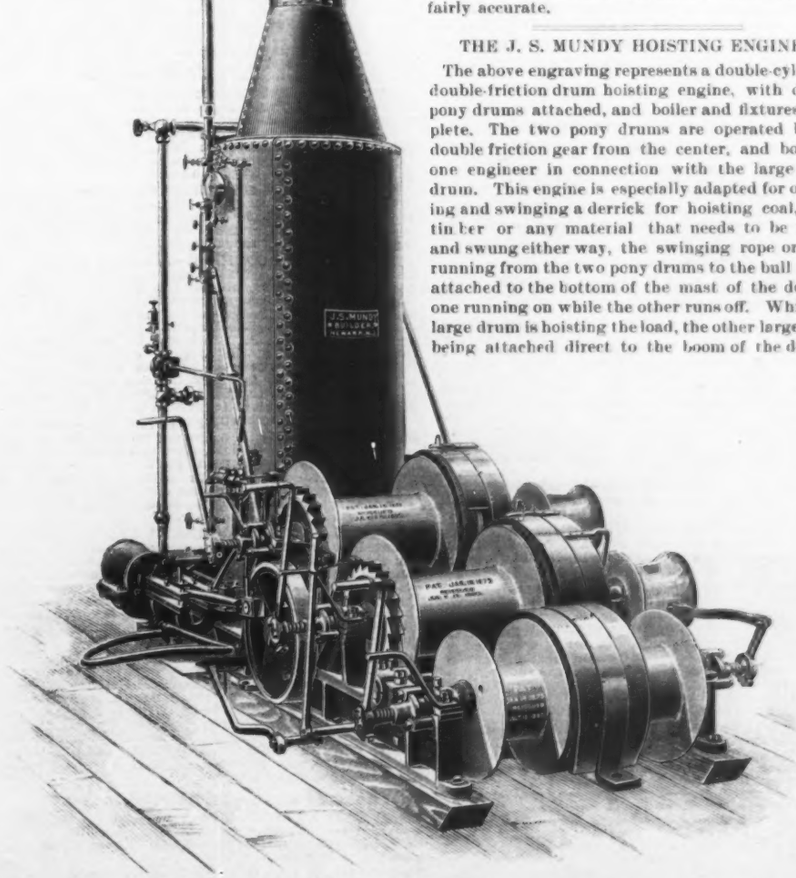
of, 44,558 or at the rate of 768 men for each 100 miles of new line brought into operation. The average number of men employed per 100 miles of line on all the railways of the United States is 479, an increase of 20 over the corresponding figures for 1889. Table V. shows the number of employees of each class per 100 miles of line in each group of states, and the average for the whole country. The statistics of section foremen and track laborers make possible a computation of the average length of a track section and the average size of a section gang in different parts of the country. We have added figures for these at the bottom of Table V., assuming that the number of sections is the same as the number of section foremen.

Of course the difference in the number of employees per 100 miles of road in the different sections of the country indexes the density of the traffic, and not the relative efficiency of the men. A table is given of the number of ton miles and passenger-miles which are made per employee of each class, showing in general that while more men are employed in the sections where traffic is dense, each man employed performs a greater amount of useful work than in the sections of light traffic. This is of course true. Any engineer or conductor can handle more traffic in the Eastern states, where heavy train loads are the rule, than in the West, where heavy grades and light traffic keep train loads small.

The remaining matter in the report, covering railway capitalization, traffic, earnings and expenses, fixed charges, and accidents, we postpone to our next issue. We reprint herewith diagrams showing the fluctuation in monthly earnings and operating expenses per mile of railway in each group of States. The nine months chosen ended March 31, 1891, so the figures are rather ancient history as far as their financial interest goes. The diagram is a good showing, however, of the variation in traffic and expenses with the different seasons of the year in different sections of the country. The mileage on which these figures are based is about 70% of the total mileage of the country, so the diagrams may be accepted as fairly accurate.

THE J. S. MUNDY HOISTING ENGINE.

The above engraving represents a double-cylinder, double-friction drum hoisting engine, with double pony drums attached, and boiler and fixtures complete. The two pony drums are operated by one double friction gear from the center, and both by one engineer in connection with the large hoist drum. This engine is especially adapted for operating and swinging a derrick for hoisting coal, sand, timber or any material that needs to be raised and swung either way, the swinging rope or chain running from the two pony drums to the bull wheel attached to the bottom of the mast of the derrick, one running on while the other runs off. While one large drum is hoisting the load, the other large drum being attached direct to the boom of the derrick,



DOUBLE CYLINDER HOISTING ENGINE; J. S. MUNDY, INVENTOR.

can raise or lower the boom, as the engineer desires, by throwing out the pawl on the end of the drum, placed there for the purpose of holding the boom line. The pawl on the upper drum can be thrown in or out, so that the load may be held stationary while the boom is being raised or lowered, or the derrick swung either way, by the pony drums, as the work calls for.

The winch heads on the end of the drum shafts can be used for hauling any material that may be desired close enough to be handled by the derrick. When the engine is placed upon the scow these winch heads are used for hauling the scow from place to place or raising the spud.

There are several of these engines now in use on the Monongahela River at Pittsburg for the purpose of dredging sand, they having been first designed and turned out by Mr. Mundy for this purpose several years ago. They are made strictly first class in every part, and are especially designed for the work as specified above. For further information and particulars apply to the inventor and builder, J. S. Mundy, Newark, N. J.

The proposed New York-Philadelphia ship canal was brought to the attention of the New York Board of Trade and Transportation this week, by a committee of prominent Philadelphia citizens, and by Prof. L. M. Haupt, of the University of Pennsylvania, who has advaneed the latest project for this canal. The canal itself has been already described in this journal on its preliminary location between Raritan Bay and Bordentown, on the Delaware. Prof. Haupt gave his views in detail after the discussion was opened by Mr. Thomas Martindale, of Philadelphia. Mr. Erastus Wiman presented a resolution, that was unanimously carried, favoring the insertion of an appropriation of $25,000 in the river and harbor bill for an examination, survey and report to the Government for a 20 ft. navigable channel on this route made by a combined board of State and Government engineers. In answer to an objection to the Government doing this the case of the Sault Ste. Marie canal was advanced.

An elevated structure is to be built in the grounds of the World's Columbian Exposition, at Chicago, and proposals will be received by Mr. D. H Burnham, Chief of Construction, until March 1, for the construction and for the equipment and operation thereon of a method of transporting visitors about the grounds. There will be about 5½ miles of single track, with about 24 passenger stations, and the necessary terminal storage yards and sheds for the equipment.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

WILLIAMS VALLEY.—A press dispatch says: "The first train has passed over the Williams Valley R. R., which connects one mile from Tower City, Pa., with the Philadelphia & Reading R. R The road will probably be extended as far west as Lykens and thence to Millersburg on the Northern Central R. R."

PHILADELPHIA & SEASHORE.—This railway, running from Winston Junction to Sea Isle City, N. J., will be sold at public auction on Jan. 19.

LANCASTER & HAMDEN.—At the recent annual meeting of the stockholders of this company the following officers were elected: Pres., John G. Reeves; V. P., Wm. B. McCracken; Treas., Philip Rising; Sec., Ben. F. Dunn, all of Lancaster, O. It is stated that arrangements have been completed for marketing the company's bonds and that construction will be resumed in the spring. The road as projected will run from Columbus and Hadley Junction, O., to the Ohio River, 140 miles, with a branch from Locust Grove to Wellston, O. About 12 miles of the line are already built and considerable additional grading done.

PLYMOUTH & MIDDLEBORO.—Material is arriving and work will soon be in progress all along this short Massachusetts road.

BUFFALO, ROCHESTER & PITTSBURG.—Work has been begun clearing the right of way for the line from Howard Junc. to Mt. Jewett, Pa., 19 miles, and it stated that grading will soon begin.

PHILADELPHIA & READING.—A survey is reported in progress for a line from Pleasantville, N. J., to Woodmancie Station, N. J., 30 miles.

NEW YORK & NEW ENGLAND.—The Executive Committee of this road has appointed a committee to consider the question of double tracking this line between New Britain and Hawleyville, Conn., about 85 miles. The change in management has also given rise to reports of extensive improvements in other directions, just what these will be, however, is not definitely known.

PENNSYLVANIA.—The contracts have been let for building the proposed double track line from Allen's Lane, on the Chestnut Hill Branch, to the Trenton Cut off, six miles. The contractors are Kelley & Crossen, Lancaster, Pa., four miles, and John T. Dewyer, Norristown, Pa., two miles.——Bridges will be built at the following points on the Roxborough Branch: Rittenhouse St., Wissahicken Creek, Monastery Ave., Fairthorne Ave., Crease's Lane, Summit Ave., and Barren Hill.——Surveys are being made for the proposed line from Ft. Washington, Pa., to Doylestown, Pa.——The following statistics of the mileage of line and track owned and operated by this company on Jan. 1, 1892, have been sent us:

"The lines East of Pittsburg and Erie aggregate in mileage 4,433 45 miles (not including 324 miles of canals and ferries), with a total of 8,546.9 miles of tracks of all kinds; being an increase of 86.85 miles of line and 258.76 miles of track during the year of 1891. The increase of line is due to the completion and extension of the following lines: New York Bay R. R. Ex., 1.74 miles; Kensington & Tacony R. R., 0.69 miles; Alloway & Quinton R. R., 4.22 miles; Pencoyd Branch, 1.24 miles; Trenton Cut-off, 44.93 miles; extensions Clearfield Branches, 8.23 miles; South Fork R. R., 7.93 miles; Turtle Creek Valley R. R., 6.44 miles; Turtle Creek Branch, Pennsylvania R. R., 2.02 miles; West Penn R. R., branches, 9.54 miles; Pittsburg & Bessemer R. R., 1.47 miles; miscellaneous extensions, 2.33 miles; total, 90.85 miles. Four miles of line have been taken up during the year, which leaves a net increase in the lines east of Pittsburg and Erie of 86.85 miles. West of Pittsburg and Erie the lines aggregate 3,412.34 miles and a total trackage of 5,129.72 miles, being an increase over the previous year of 15.26 miles of line and 115.89 miles of track. The increase in mileage is on the Pittsburg, Youngstown & Ashtabula R. R., 5.88 miles; Margina R. R., Beaver Falls, Pa., 2.96 miles; Grand Rapids & Indiana R. R., Haak's Spur, 4.00 miles; miscellaneous extensions, 2.33 miles. The total of all lines (East and West of Pittsburg and Erie) in which this company is interested shows a mileage of 7,845.79 miles of railway line, 13,676.62 miles of railway track, and 324 miles of canals and ferries, an increase during the year of 102.11 miles of railway and 374.64 miles of track of all kinds.

CONCORD & MONTREAL.—It is stated that this company will endeavor to secure power from the Massachusetts Legislature to build an extension from North Acton to Belmont, Mass., about 16 miles, to secure an independent line into Boston. According to press reports, preliminary surveys have been made, and considerable other work done toward the construction of the line.

WEST VIRGINIA CENTRAL & PITTSBURG.—The Baltimore & Cumberland Railroad Co. has been chartered in Maryland, in the interest of this company, to build a railway from Cumberland to Baltimore, Md. Surveys have been completed from Cumberland to Hagerstown, Md., and from Hagerstown to Baltimore, it is probable that arrangements will be made to run over the Western Maryland R. R. Among the incorporators are: John A. Hambleton, Baltimore, Md.; Buchanan Schley, Hagerstown, Md.; Henry G. Davis, Piedmont, W. Va.

BALTIMORE & OHIO.—It is stated that work will be begun at once on the Washington & Western Maryland R. R. and the line completed by March 1, 1892.

Projects and Surveys.

WASHINGTON & CHESAPEAKE BEACH.—This company, which proposes to build a railway from Washington, D. C to Chesapeake Beach, Md., 30 miles, has begun the survey of its line. Secy., T. W. Tyrer, Washington, D. C.

EASTERN CENTRAL.—A press dispatch says: "The Eastern Central, the road proposed to parallel the great Pittsburg, Fort Wayne & Chicago, is being talked about again, and Daniel Babst, the new president of the company, is setting forth some claims. He declares that work will surely begin this summer, and that the road will be completed between Bowerstown, a short distance east of New Philadelphia, O., and Galion, Crawford Co., at which place division shops will be located. From Galion, it is claimed, the road will be pushed in an air line to Kenton, and thence further west. As to the routes east of Bowerstown and west of Kenton, nothing definite has been decided upon as yet. President Babst evinces much enthusiasm and determination, and while many view the the project in doubt, others take stock in it."

SANDUSKY, ASHLAND & SOUTHERN.—It is stated that this company will begin at once the survey for its proposed line from Sandusky to Loudonville, O. The surveys will be under the direction of J. C. Brewer. The officers of the company are: Pres., John Mackey; V.P., C. P. Wickham; Secy. and Treas., A. W. Miller; and Gen. Man., John C. Hoxie, all of Sandusky, O.

MANISTIQUE & NORTHWESTERN.—The survey for this proposed railway from Manistique to Negaunee, Mich., 91 miles, has been completed. A favorable route is said to have been secured. Martin H. Quick, of Manistique, Mich., is one of the incorporators.

BANGOR & AROOSTOOK.—Albert A. Burleigh, of Houlton, Me., Pres., writes us that the locating surveys have been made for 230 miles of this Maine railway and that contracts for construction will be let in the spring. The road will pass through a rich agricultural and timber region. The work is quite favorable; maximum grade 1% and maximum curve 6°. There will be several bridges, the longest of which will be 375 ft. About two-thirds of the right of way has been secured and $500,000 of bonds have been voted by Aroostook Co., and about $300,000 in stock subscribed by the people along the route. It is expected to have a portion in operation by Jan. 1, 1893.

READING, LANCASTER & BALTIMORE.—Nearly all the money necessary to secure the construction of this railway is said to have been secured and preparations are being made to begin work soon. The line as projected is to run from Reading, Pa., south to the Maryland line, 70 miles, to connect with a line from Perryville, Md., north, with a branch to Lancaster, Pa., about 8 miles. S. C. Slaymaker, Lancaster, Pa., Ch. Engr.

PITTSBURG, CANNONSBURG & STATE LINE.—It is stated that right of way is practically secured for this railway from Pittsburg, Pa., to Wheeling, W. Va., and that the road will probably be put under contract in the spring. This scheme was first started in 1887, and since that time its promoters have been endeavoring to secure the money necessary to carry it out. It is now reported that sufficient stock has been raised to warrant the beginning of work.

ZANESVILLE, NEWCOMERSTOWN & CLEVELAND.—The following directors were elected at the recent annual meeting: A. M. Beers, of Newcomerstown; Edward Spencer, of Waverly; H. H. Squair, of Cincinnati; J. F. Fletcher, of Nashville, Tenn.; Willis Bailey, Edmund Turner and Benjamin Wheeler, of Zanesville. The directors organized by electing A. M. Beers Pres., Edmund Turner V.-P., Benjamin Wheeler Treas., and D. B. Linn Sec. The company proposes to build a railway from Zanesville to Cleveland, O.

Southern.—Existing Roads.

GEORGIA, CAROLINA & NORTHERN.—This line has now been opened for traffic to Lawrenceville, Ga., 25 miles east of Atlanta, Ga., and 237 miles from its eastern terminus at Monroe, N. C.

FARMVILLE & POWHATAN.—It is stated that a bill will be introduced into the Virginia Legislature, giving this company power to broad gauge its line and build an extension into Manchester, Va.

MACON, DUBLIN & SAVANNAH.—There is considerable newspaper talk of the extension of this railway from Macon to Savannah, Ga. Little else seems to have been done, however.

ROANOKE, FINCASTLE & CLIFTON FORGE.—C. H. Vines, Fincastle, Va., Pres., writes us as follows: "This railway is projected to run from Roanoke, Va., via Fincastle, to Eagle Rock, Va., 35 miles, and twelve miles of the line have been graded. It is expected to begin tracklaying on this 12-mile section by April 1 and to have it completed by May 1."

Projects and Surveys.

MISSOURI, EAST TENNESSEE & VIRGINIA.—The contract for building the first section of this railway, 110 miles, will soon be let. L. A. Wolkins, Secy., Baltimore, Md.

MARION & RYE VALLEY.—Preliminary surveys are being made for this short line from Marion, Va., to mines. W. C. Foster, 52 Broadway, New York City, Ch. Engr.

OXFORD & COAST LINE.—Contracts will soon be awarded for building this line from Oxford, N. C. east to a connection with the Atlantic Coast Line.

NEWSOM LUMBER CO.—This company will probably want 5 miles of 20-lb. rails. Address, Suffolk, Va.

GAINESVILLE, LA CROSSE & LAKE BUTLER.—This company has completed its organization by the election of the following officers: Pres., I. F. Webster; V. P., J. S. Twomey; Secy., C. L. Fildes, and Treas., J. R. Eddings. It is stated that surveys will begin in a few weeks.

GURLEY & PAINT ROCK VALLEY.—This company has increased its capital stock $150,000 and will issue bonds. The road is to run from Winchester to Deposit, Ala., and surveys will be commenced soon. Pres., Frank Gurley, Gurley, Ala.; Secy., E. L. Walker, and Ch. Engr., Samuel I. Wheatcroft.

JONESVILLE & LOCKHART SHOALS.—Elections will soon be held in the townships of Jonesville and Pinckney, Union Co., S. C., to vote upon the proposition of subscribing $20,000 each in aid of this proposed railway.

RICHMOND, BLACKSTONE & SOUTHERN.—A bill has been introduced into the Virginia Legislature to charter this company with power to build a railway from Richmond, Va., to Ridgeway and Henderson, N. C.

NORFOLK & SOUTH MILLS.—A bill is before the Virginia Legislature incorporating this company to build a railway from some point on the southern branch of the Elizabeth River, Norfolk Co., Va., to the North Carolina line. Among the incorporators are E. A. Buell, F. J. Stowe, S. D. Pulier and others.

POTOMAC RIVER & GREAT FALLS.—A bill is before the Virginia Legislature incorporating this company to build a railway from Great Falls, Fairfax Co., Va., to a point on the Potomac River. Among the incorporators are R. W. Moore, B. F. Mackall and J. M. Love.

RICHMOND, GAYTON & HENRICO.—A bill has been introduced into the Virginia Legislature to incorporate this company to build a railway in Henrico, Chesterfield, Goochland and Powhatan counties.

ALABAMA.—The survey for a railway from Florence, Ala., south to the Gulf of Mexico, which was ordered at the last session of the Alabama State Legislature, has been completed. The survey was under the direction of John A. Milner, who reports a very favorable line secured. The survey is open to any responsible company which will undertake to build a railway over it.

Northwest.—Existing Roads.

SIOUX CITY, MADISON & NORTHERN.—It is stated that the extension of this railway from Garretson to Madison, Ia., is practically assured. A large amount of the right of way has been donated and about $2,500 raised by the people of Madison.

DULUTH, RED WING & SOUTHERN.—At the recent meeting of the stockholders of the Duluth & Sioux City Construction Co., the following officers were elected: Pres., L. F. Hubbard; V. P., T. B. Sheldon; Sec., F. W. Hoyt; Treas., G. H. Crary. The company has decided to make a complete survey of the proposed line from Red Wing to Duluth, Minn.

CHICAGO & ALTON.—A press dispatch from Bloomington, Ill., says: "The Chicago & Alton R. R. Co. has begun the work of improving its roadbed and rolling stock, with a particular view to benefiting its service during the World's Fair. The company has decided to expend $500,000 for these purposes, and an order has just been received by Master Mechanic Quackenbush in this city to buy a number of the largest and finest locomotives made. They are to be ten-wheelers, and will be both powerful and speedy. The shops in this city will be run to their greatest capacity in manufacturing engines and coaches. Thirty new passenger coaches are now under way in the shops in this city. At all of the crossings interlocking switches with the latest safety appliances will be put in. Many of the bridges, particularly the overhead bridges, will be taken down and a low deck iron bridge will be put in. Nearly all of the smaller bridges are to be relaid with iron floor beams, and across hundreds of the smaller sloughs the tracks are to be tiled with 36-in. iron pipes to let the water through. The double track between this city and Chicago will be completed not later than June 1."

DULUTH & IRON RANGE.—This company has begun the survey of its proposed branch from Mesabi Station, Minn., west along the iron range.

DULUTH & WINNIPEG.—At the recent annul meeting of this company a complete change was made in the management. A. W. Wright, of Saginaw, Mich., was elected President in place of B. M. Baker, of Baltimore, Md. It is stated that sufficient funds have been raised and that the road will be extended directly west from Grand Rapids, Minn.

Projects and Surveys.

MANKATO & NORTHEASTERN.—At a recent meeting of the incorporators it was decided to begin surveys for this proposed line from Mankato, Wis., to Farmington, Minn.

CHICAGO, KEOKUK & SOUTHWESTERN.—Jas. H. Anderson, Keokuk, Ia., writes us that the organization of this company has not been completed and the work has not been definitely decided upon. The line will run from Havana, Ill., to Keokuk, Ia., and thence southwest about 200 miles, and surveys will probably begin in March, 1892.

PUEBLO & DULUTH.—O. A. Williams, Neligh, Neb., writes as follows:

"This railway is projected to run from Sioux City, Ia., via Ponca, Randolph, Neligh, Ord, Arcadia, Stockville and Culbertson, Neb., to Pueblo, Colo., 909 miles. About 500 miles have been surveyed and a very favorable line secured. The maximum grade is 1% and the maximum curve 3°. There will be only a few bridges. About 80 miles of the right of way have been secured and $1,200,000 in local aid obtained. It is intended to let contracts for a portion of the work about May 15, 1892. Pres. D. Hitchcock; Ch. Engr., C. H. Collins; both of Neligh Neb."

Southwest.—Existing Roads.

VELASCO TERMINAL.—It is expected to have this road completed from Velasco to Chenango, Tex., 22 miles, by Feb. 1. Up to Jan. 5, nine miles of track had been laid.

AUSTIN & NORTHWESTERN.—According to press reports grading on the extension from Fairland to Llano, Tex., 30 miles, began Jan. 15.

MISSOURI, KANSAS & TEXAS.—Gen. Supt. J. J. Frey, Parsons, Kan., will receive bids until Feb. 1, 1892, for constructing a brick passenger station at Nevada, Mo. Plans and specifications can be seen at the office of M. A. Martin, Sedalia, Mo.

CHICAGO, ST. PAUL & KANSAS CITY.—The St. Joseph, Tarkio & Northwestern R. R. Co. will issue $1,500,000 of bonds to provide for the construction of its lines from Savannah, Mo., to Tarkio, Mo.

CHICAGO, ROCK ISLAND & PACIFIC.—The contract for building 18 miles of the proposed extension from Minco, Ind. Ter., south, has been let. This will take the line to the Washita River. Surveys are in progress between the Washita River and Ft. Worth, Tex.

Projects and Surveys.

FT. WORTH & DALLAS RAPID TRANSIT.—This company has been chartered by J. A. James and S. M. Butler, of Kings Co., N. Y.; A. M. Carter, L. J. Boax, Max Elser and others, of Fort Worth, Tex., to build a railway from Fort Worth to Dallas. It is to be standard-gage, have 60-lb. steel rails and will be about 32 miles long. The motive power to be used will be either steam or electricity. Engineers have been surveying the route and it is intended to commence work in about two weeks, and have the road completed by July 1, 1892. The estimated cost of building and equipping the line is $500,000.

RAVENDEN SPRINGS LAND CO.—This company will probably build a railway from Ravenden Springs, Ark., to the Kansas City, Ft. Scott and Memphis R. R. John B. Jones, Little Rock, Ark., is at the head of the enterprise.

OMAHA, KANSAS CENTRAL & GALVESTON.—At the annual meeting of this company recently held the following officers were elected: Pres., S. O. Constant, New York City; V. P., C. M. Rawlings, Lyons, Kan.; Sec., V. Sillo, New York City, and Aud., D. M. Bell.

TRINITY & TEMPLE.—F. H. Steber has begun surveys for the proposed railway from Trinity to Temple, Tex. After the survey has been finished the company will submit a proposition to the Missouri, Kansas & Texas Ry. to build the line.

Rocky Mt. and Pacific.—Existing Roads.

GREAT NORTHERN.—About 500 men are now at work on the wagon road and making the preliminary arrangements for beginning the construction of this line from Everett, Wash., east along the Skykomish River.

SAN FRANCISCO & NORTH PACIFIC.—It is stated that the Guerneville Branch of this road will soon be extended considerably further into the redwood forests. An extension of 1½ miles was built during 1891.

SUMPTER VALLEY.—This railway, which has recently been completed from Baker City, Ore., into the Sumpter Valley, 25 miles, will not be opened for traffic until spring. The road penetrates a fine timber and mineral section of the state.

Projects and Surveys.

PORT ANGELES SOUTHERN.—C. E. Maliette, of Port Angeles, Wash., writes us that the surveys have been completed for this railway from Port Angeles to Junction City, Wash., 32.5 miles. The line is comparatively straight and level, and the work will be light. There will be four large bridges. It is expected to let the contracts for construction by March 1, 1892, and to complete the line during the year. Prest., F. S. De Wolfe, Seattle, Wash.; Ch. Engr., A. J. Blackwood, Port Angeles, Wash.

SALT LAKE & OGDEN.—Chartered in Utah Territory to build a railway from Salt Lake City to Ogden, Utah, a distance of 52 miles. Among the directors are: E. D. Egan, Wm. Fuller, Nich. Treweek and others.

SEATTLE, TACOMA & PORTLAND.—The officers of this company, which has been chartered to build a railway from Tacoma to Seattle, Wash., about 30 miles, are: Pres., F. H. Osgood; V. P., Herman Chapin; Treas., D. N. Baxter and Sec. Josiah Collins. It is stated that the road will be operated on the Boynton bicycle principle. The surveys have been made and right of way is being secured.

HELENA & CASTLE.—The project to build a railway from Helena to Castle, Mont., is again being agitated.

CERILLOS COAL.—The Cerillos Coal R. R. Co. has been chartered in New Mexico to build a railway from Cerillos to San Pedro, N. Mex., 76 miles. Among the incorporators are: A. J. Taylor, Chicago; Chas. H. Smith, St. Louis, Mo., and R. J. Palen, Santa Fe, N. Mex.

Foreign.

COAHUILA & DURANGO DEVELOPMENT CO.—This company has been chartered in Colorado to build a railway from Torreon to Durango, Mex. The incorporators are H. A. Parley, Geo. H. Parsons, Jas. M. Holton and others, of Colorado Springs, Colo. The Mexican International Ry. Co. already has a line under construction between these same points, and it is possible that the new company has been organized in its interest. Otherwise there seems little probability of it carrying its scheme through.

MEXICO.—President Diaz has ordered a new concession signed with Albert K. Owen to build a railway from Topolobampo Harbor to Presidio del Norte on the Rio Grande. The concessionnaire has ten years to complete the line. He will receive 10,000,000 acres of land in the five northern states as a bonus. These lands are particularly desired by the concessionnaire, as he has a large body of colonists organized who are anxious to settle them to develop agriculture, lumber, mines, and manufactures.

ELECTRIC RAILWAYS.

BROOKLYN, N. Y.—The State Railroad Commission has granted the application of the Brooklyn & Coney Island Ry. Co. for permission to introduce the overhead wire electric system on its line from Hamilton Ferry to Flatbush.

MONTGOMERY, ALA.—An ordinance for an electric railway has been granted to Paul W. Smith.

ST. LOUIS, MO.—The St. Louis & Kirkwood Rapid Transit Co. has been granted a franchise for an electric road. Work is to be commenced in 2 years. Mr. E. B. Shurzer is the attorney for the company.

PORTLAND, ORE.—The Portland & Southwest Ry Co. has been incorporated by O. H. A. Sharey, Edward Hughes and Wm. W. Spaulding. Capital stock, $20,000.

STOCKTON, CAL.—The Stockton Electric Ry. Co. has been incorporated, and work is expected to be commenced within 60 days. Capital stock, $500,000. Pres., J. S. Bostwick; Secy, Joseph Fyfe; Treas., E. R. Hedges; Supt., E. Ladd.

HORSE RAILWAYS.

NEW ORLEANS, LA.—The franchise of the Crescent City Ry. for a period of 25 years will be sold at auction by the City Comptroller, April 4. New or rebuilt tracks are to be laid with girder rails, 10 ins. deep, for paved streets. On unpaved streets the space between the rails is to be laid with yellow pine planks, 3 × 12 ins., placed transversely. The purchaser will be required to do a certain amount of paving.

HIGHWAYS.

NEW JERSEY.—It is proposed to appropriate $100,000 annually from the revenues of the state to be devoted to a road fund, and a convention of farmers will be held Jan. 21 to promote this appropriation.

VIRGINIA.—A meeting will be held at the Dinwiddie Co. Court House, Petersburg, on Jan. 18 to consider the issue of $75,000 bonds for road improvements.

BRIDGES, TUNNELS AND CANALS.

NEW BRUNSWICK, N. J.—At a recent meeting of the Board of Chosen Freeholders of Middlesex Co., N. J., it was decided to erect a stone arch bridge over the Raritan River, at the foot of Albany St., New Brunswick. The structure will cost about $100,000.

TIFFIN, O.—The Commissioners of Seneca Co will until Feb. 1, receive proposals for performing the labor and furnishing the materials for superstructure for bridge across Rock Creek, on Circular St. Plans submitted must show nature, size and quality of material used, strength of structure when completed, and whether there is any patent right on proposed plan or any part thereof. Superstructure to have single track, 50 ft. long, 30 ft. wide, and two footways, each 15 ft. wide. Address N. Burtscher.

INDIANAPOLIS, IND.—A bridge will probably be built over Fall Creek on Alabama St.

BAY CITY, MICH.—Bids will soon be asked for constructing the proposed 23d St. bridge.

MT. CLEMENS, MICH.—A new $15,000 bridge will be built over Clinton River.

PECOS, TEX.—J. B. Gibson will receive bids until Feb. 15 for the construction of an iron bridge across the Pecos River near Pecos; bridge to be 150 ft. long and have a roadway 12 ft. wide.

WAHKIAKUM CO., WASH.—Bids will be received for building a drawbridge and trestle approaches. O. M. Harvey, County Auditor, Kathlamet, Wash.

SAN FRANCISCO, CAL.—Raymond & Bay, Civil Engineers, San Francisco, Cal., are preparing plans for a steel drawbridge over Napa River.

NEW ORLEANS, LA.—The New Orleans Canal Cons. & Imp. Co. has been incorporated with C. F. Collon as President and Abraham Rosenfeld, Secretary, for the purpose of digging and culverting canals.

WATER-WORKS.

New England.

ARLINGTON, MASS.—A better water supply is being discussed, and A. D. Hoitt and A. J. Tillson, Water Comrs., and others have been appointed to investigate the matter. Prooably nothing will be decided before March.

ATHOL, MASS.—The works have been sold to a Portland firm and will hereafter be under the management of Geo. F. West, of that city. Improvements are projected. A. McDonald, Superintendent.

ATTLEBORO, MASS.—The district has just voted to petition the legislature for authority to issue $75,000 at 5%, 10-40 bonds to be used in extending the mains and securing an additional supply. Geo. A. Dean, Chn. Com. on investigation

CAMBRIDGE, MASS.—Bonds to the amount of $100,000, running 20 years at 4%, are to be issued for building or improving a reservoir.

TAUNTON, MASS.—A new supply is under consideration, but nothing definite has been done. Supt., Geo. F Chace.

TEMPLETON, MASS.—Works for a gravity supply is being discussed.

WALTHAM, MASS.—It is reported that a new force main will be laid this spring.

Middle.

BLISS, N. Y.—The "Herald" of this place thinks that works may soon be built and states that an engineer has examined some springs above the village and "pronounced the supply inexhaustible."

MECHANICSVILLE, N. Y.—It is reported that contracts for the village works may be let before Feb. 1; also that about 1,400 tons of iron pipe will be required. Engr., P. H. Baermann, Troy.

MEDINA, N. Y.—Bids for works, probably to be owned by a company, will be received until Jan. 20.

NEWBURG, N. Y.—Bids will be received until Jan. 20 for work necessary to increase the supply. This work includes the removal of some 200,000 cu. yds. of muck, raising of dams and constructing an open conduit, all at an estimated cost of about $120,000. Engr. John D. Van Buren has charge of the work, and should be addressed for forms of proposals and other information.

PORT JERVIS, N. Y.—It is reported that the Port Jervis Water Co. will increase its capital stock from $45,000 to $90,000, build a new dam, lay a new 24-in. supply main from the reservoir and lay new mains in different sections of the village. The purchase of the works by the village is advocated by some of the citizens and by the "Gazette."

SUSPENSION BRIDGE, N. Y.—It is reported that the sum of $6,000 is available and will be expended for improvements.

TONAWANDA, N. Y.—Bonds to the amount of $150,000 will be issued by the village to pay for the works recently bought from the company.

CAMDEN, N. J.—According to reports Isaac A. Braddock and others have offered to deliver water to the city for one cent per thousand gallons. The supply would be by gravity from ponds and streams in Camden Co., near Milford and Gibtsboro.

RIDGEWOOD, N. J.—The Ridgewood Village Water Co. has been incorporated by J. H. Pratt and H. F. Torrey, probably of Montclair, and others; authorized capital stock, $150,000; purpose, to supply water to cities, towns and villages in the state.

WORTENDYKE, N. J.—The Wortendyke Water Company has been incorporated by the same parties as are mentioned above under Ridgewood; authorized capital stock, $100,000.

BRYN MAWR, PA.—The Merion Water Co. has applied for a charter; proposed capital, $10,000; directors, A. J. Cassatt and John H. Converse and others; Treas., Walter H. Wood.

CHARTIERS, PA.—The People's Water Co. has been incorporated; capital stock, $10,000.

ELMHURST, PA.—The Elmhurst Water Co. has been incorporated; capital stock, $10,000.

LEWES, PA.—Works are talked of.

MANSFIELD, PA.—The Union Water Co. has been chartered; capital stock, $10,000.

NEWMANSTOWN, PA.—A company with a reported capital stock of $6,000 has been formed here to supply water to this place, Sheridan, and possibly to Womelsdorf. Application has been made for a charter. The supply, as proposed, will be from South Mountain, about 1½ miles from Newmanstown. Some 5 miles of mains will be used. Address Eli Wallace.

READING, PA.—Ten-year 4% bonds to the amount of $70,000 are for sale. Address City Clerk.

WILLIAMSTOWN, PA.—The Williams Valley Water Co. has been incorporated; capital stock, $40,000.

Southern.

KEY WEST, FLA.—A water supply for fire protection is strongly urged by the "Democrat" of this place.

HATTIESBURG, MISS.—Works are wanted.

ALEXANDRIA, LA.—J. G. Coullard, representing Welsh & Marye, Philadelphia, has asked for 30-year waterworks and electric lighting franchises. The Council had not taken action at the last report.

JONESBORO, TENN.—A proposition to build works is under consideration. A spring above the town is the proposed source of supply.

PARKLAND, KY.—Works are still projected.

North Central.

MICHIGAN CITY, IND.—It is reported that new works will be built.

CLINTON, MICH.—Works are reported as projected.

ST. JOSEPH, MICH.—It is reported that the contract for works has been awarded to J. V. Newcomer, Cleveland, O., for $49,000, payable in bonds drawing 6% for three years and 5% thereafter. There will be a stand-pipe 100 ft. high.

SOUTH HAVEN, MICH.—It is reported that the contract for works has been let to the Lansing Iron & Engine Works for $29,000. Another report states that Geo. S. Pierson, Kalamazoo, has the contract for $28,250. These contracts may cover different parts of the works.

CHICAGO, ILL.—Estimates for operating expenses and construction during the current year, not including distribution extensions, make a grand total of $1,769,500. Of this sum $50,000 is for improvements at the various pumping stations including a small pump and about $420,000 for carrying on tunnel and allied work.

FREEPORT, ILL.—It is reported that a franchise will soon be asked by a new company, which propose to build competing works.

OTTAWA, ILL.—An adequate supply of water for general use is still talked of. City ownership is urged by some.

KAUKAUNA, WIS.—An item regarding works here was in last week's issue, by means of typographical error, located in New York.

Northwestern.

DUBUQUE, IA.—The Mayor has introduced a resolution in the City Council instructing the Dubuque Water Co. to build a new pumping station and seven tanks or reservoirs in different sections of the city. The resolution has been referred to a committee and the city attorney.

REDWOOD FALLS, MINN.—The people have voted $25,000 in bonds for works.

STURGIS, S. DAK.—It is reported that an eastern company has applied for a franchise.

Southwestern.

EXCELSIOR SPRINGS, MO.—The people have voted to grant a franchise to the Excelsior Springs Light & Water Co.

ARKANSAS CITY, ARK.—The Arkansas City Improvement Co. has been incorporated at Jersey City, N. J., to build water-works, operate and dispose of same, and to build, lease and operate railways; authorized capital stock, $50,000, of which $1,500 is paid in; incorporators, W. R. Bergholz, J. F. O'Shaughnessey & Co., and H. Odell, New York City.

ELGIN, TEX.—The construction of works was started Jan. 6.

WICHITA FALLS, TEX.—Machinery for boring an artesian well for water-works has just been bought.

LAFAYETTE, COLO.—The City Council has voted to issue $16,000 of bonds for works. A reservoir site has been located. It is proposed to have works in operation by April 1.

Pacific.

COLFAX, WASH.—A 500,000-gallon pump will be bought for the new city works. Address City Clerk.

EVERETT AND LOWELL, WASH.—The Everett Water Co. proposes to supply each of these towns, and is now building a dam across a gulch two miles south of Lowell. The dam will form a 4,000,000-gallon reservoir and will furnish power for pumping.

POCATELLO, IDA.—The Council has granted a franchise to the new company. J. J. Cusick, Dr. F. D. Toms and Jos. Murray are interested. Works must be completed within 12 months.

Canada.

PEMBROKE, ONT.—The proposition to build works has been defeated.

ARTESIAN WELLS.

MANCHESTER, N. H.—A well at the city farm is proposed.

MOBERLY, MO.—There is talk of the sinking of a well by the city.

IRRIGATION.

ANAHEIM, CAL.—Anaheim Irrigation District bonds to the amount of $600,000, it is reported, will soon be sold, after which extensive works will be built.

REDLANDS, CAL.—Bids are wanted until March 1 by the Bear Valley Irrigation Co., E. M. Boggs, Engr., for driving 6,000 ft. of tunnel through rock. Bidders may propose to furnish their plant or to use a complete plant owned by the company.

SOUTH RIVERSIDE, CAL.—The South Riverside Land & Water Co. proposes to build a ditch to water 3,000 acres.

NEW COMPANIES.—Central Irrigating Co., Gering, Neb., $5,000; Martin Gering, Albert Stear and others. Tule Irrigation Co., Pecos City, Tex.; $10,000. Eckerly Canal Co., Montrose Co., Colo.; $50,000; to complete Selig ditch. North Platte Land & Water Co., Denver, Colo.; $300,000; directors, J. H. Noble, John Taylor and others; Chas. W. Aldrach, Mgr. Lower Boulder Extension Reservoir Co., Longmont, Colo.; $5,000; S. S. Pease, C. M. Brown and Newton Mathews. Gila Bend Land & Water Co., San Bernardino, Cal.; $25,000; directors, Smith Haile, W. N. Crandall and others. Rio Verde Canal Co., Phœnix, Ariz.; $3,000,000; survey under way to take water from Rio Verde to irrigate land north of Phœnix. Herriman Irrigation Co., Herriman, Utah; $11,550; Prest., J. J. Freeman; Secy., J. S. Crane.

SEWERS.

PORTLAND, ME.—According to the new contract the Portland & Rochester R. R. agrees to build a sewer in Deering's Oaks, 5 ft. inside and 1,875 ft. in length, according to specifications of the City Engineer. The cost is estimated at about $12,000.

MARLBORO, MASS.—The Committee on Sewerage has completed 17 miles of sewers and reports that 4 or 5 miles more are needed to cover the principal streets.

PITTSFIELD, MASS.—Mayor Peck makes special mention in his inaugural address of the new sewerage system upon which he says at least $100,000 will be spent this year.

WOONSOCKET, R. I.—The engineers engaged to consider the sewerage plans have submitted their report to Mayor Pond.

GREENPORT, N. Y.—A new sewerage committee has been appointed to determine the feasibility of a sewerage system and to report on or before March 1. B. D. Skinner and J. M. Wells are members of the committee.

MECHANICVILLE, N. Y.—Engineer Smalley, of Syracuse, is making a preliminary survey of the village for sewers.

TROY, N. Y.—A report has been adopted in favor of brick sewers on two streets.

ATLANTIC CITY, N. J.—At a recent meeting of the Board of Health it was recommended that the city purchase the present sewerage system or build one of a similar character.

SUNBURY, PA.—The Lewis-Mercer Construction Co., of New York, has made the city a proposition for putting in a complete system of sewerage.

CUMBERLAND, MD.—The Lewis-Mercer sewerage ordinance, which was duly noted as made a law several weeks ago, has been repealed, and it is now suggested that a competent engineer be secured and plans prepared for a complete system to be constructed by the city.

LYNCHBURG, VA.—City Engineer Rhodes has prepared estimates for new sewers, aggregating $32,534.

ATLANTA, GA.—Ordinances have been passed for three new brick and stone sewers to cost $66,000.

MONTGOMERY, ALA.—The city will soon commence work on the construction of a south outfall sewer to cost about $8,000.

NEW ORLEANS, LA.—Mr. J. F. Le Baron, of Jacksonville Fla., has completed an elaborate report, with specifications, for the construction of levees for protecting the city, and for the drainage and sewerage of the city; a work of great importance, and which will require a very large expenditure of money.

NORWOOD, O.—Specifications have been prepared for the construction of main sewers.

NEW ALBANY, Ind.—The Mayor will receive proposals until Feb. 1 for the construction of a sewer on Stone and West Sts.

MENOMINEE, MICH.—The contract for a brick and siphon pipe sewer outlet was awarded Jan. 7 to J. J. Crilley, of Milwaukee, at $10,015. Other bids were: C. Wells, $11,020; James & Foley, $12,240; N. Forethal, $12,385.

FREEPORT, ILL.—Plans and specifications for a complete system have been accepted. A culvert 2,200 ft. in length and to cost about $7,000 will be constructed soon.

HEMPSTEAD, TEX.—Mr. Boggs, Engineer for the Houston & Texas Central R R., is preparing plans for a proper drainage system for the city.

DENVER, COL.—The City Council has appropriated $20,000 additional for the storm and combined sewers tributary to Delgany St.

STOCKTON, CAL.—The Board of Public Works will ask bids for pipe for storm sewer. E. E. Tucker is preparing the necessary specifications.

STREETS.

HACKENSACK, N. J.—The preliminary steps are being taken to submit to the people the question of bonding for additional macadam, the purpose being to complete the work on all streets this year, if possible.

JERSEY CITY, N. J.—The contract for the improvement of Jackson Ave. has been awarded to Chas. O'Neill; that for 9th and 11th Sts. was awarded to Henry Byrne.

ALLEGHENY, PA.—The estimates for the Dept. Pub. Wks. for 1892 include $90,000 for streets, and $114,000 for sewers and highways.

LOCK HAVEN, PA.—The paving of Main St., is estimated to cost $15,000. It is proposed to appropriate annually $10,000 for paving in addition to the ordinary required outlay for street repairs and improvements.

SUNBURY, PA.—Should the Lewis-Mercer Construction Co. be granted the proposed sewer franchise, the same company agrees to put in 8 miles of brick pavement and grant the city 20 years in which to pay for it.

WASHINGTON, D. C.—Capt. Febiger recommends that brick sidewalk be laid and curb set on the north side of Elm St., between Harewood and Le Droit Aves., Le Droit Park.

ATLANTA, GA.—It is expected that Peachtree St. will soon be paved with asphalt its entire length. The matter is being thoroughly agitated and with apparent success. The first steps have been taken toward extending Alabama St. into West Atlanta, a very expensive extension if carried to completion.

CINCINNATI, O.—The Clerk of the Board of Administration has been authorized to advertise for proposals for keeping 6 streets in repair for 5 years. Bids are now asked until Jan. 30 for grading, curbing and macadamizing one street, and paving, with granite blocks, one street; until Feb. 3, for blocks, one street; until Feb. 4, macadamizing one street, and paving with vitrified brick, two streets.

DAYTON, O.—Bids are asked by the Board of City Commissioners until Feb. 5 for paving contracts aggregating 111,100 sq. yds.

NEWARK, O.—The City Clerk desires bids until Feb. 1 for all labor and materials pertaining to the paving of East Main St. with bricks.

SPRINGFIELD, O.—City Engineer Linn has presented estimates for paving aggregating 7,779 ft. and to cost $94,278.

NEW ALBANY, IND.—Bids will be received at the Mayor's office until Feb. 1 for the improvement of two streets.

STREATOR, ILL.—The Council has directed that Main St. be paved with brick.

ST. LOUIS, MO.—Proposals are asked by the Board of Public Improvements until Jan. 26 for five contracts for grading, Telford pavement to be laid on one street and pine wood blocks on one.

CISCO, TEX.—Civil Engineer Thatcher, of Dallas, has been requested by the City Council to prepare estimates for street grading, bonds having been cashed for that purpose.

LOS ANGELES, CAL.—Several streets have been ordered graveled, and one street paved with bituminous lime rock.

SAN BERNARDINO, CAL.—One street is to be paved with vitrified brick.

ELECTRICAL.

SOUTH MANCHESTER, CONN.—An electric light system is to be put in, and the plant will be a continuation of the Manchester system.

JERSEY CITY, N. J.—City Clerk Bouton has been directed to readvertise for bids for street lighting.

REYNOLDSTON, PA.—The McKeesport Light Co. offers to supply 2,000 c. p. arc lamps at $100 each per year.

MANCHESTER, VA.—A contract has been made with the Richmond Railway & Electric Co. for furnishing 25 arc lamps of 1,200 c. p. at $5 per night for five years.

ELIZABETH CITY, N. C.—Estimates for an electric light plant will be received by E. F. Aydutt, President of the Elizabeth Improvement Co.

MOBILE, ALA.—The committee has recommended for adoption the bid of the Economical Electric Light Co., of New York, on its schedule of $86 a light per year up to midnight, and if no moon then to burn all night. They recommend 181 lamps. The city is now paying $91 per lamp on the moon schedule.

ALEXANDRIA, LA.—Mr. J. G. Goullard, representing Welsh & Marye, of Philadelphia, has applied for a franchise to erect an electric light plant. The town is offered 100 lights for $2,000 annually.

WEST BEND, WIS.—The city has contracted for 480 lights.

DUBUQUE, IA.—The city has contracted with the Edison Electric Light Co. for 200 street lights, at $64 each per year, by the Philadelphia moon schedule, or $100 for all night.

WAHPETON, N. DAK.—The city is now paying $1,800 per year for 10 arc lights, and is agitating the question of purchasing the lighting plant and putting in 20 additional lights.

WICHITA FALLS, TEX.—An electric light franchise has been granted to the Wichita Falls Electric Light Co.

BOULDER, COLO.—The Boulder Electric Light Co. is to enlarge its plant this year. One or two new boilers and probably another large engine and two dynamos will be required.

SAN FRANCISCO, CAL.—The California Electric Light Co. has contracted with the Edison General Electric Light Co., of New York, to charge the overhead system to the conduit or underground system. The contract price is $500,000, and the work will be done at once.

NEW COMPANIES.—Castle Electric Co., Castle, Mont.; John L. Frazer, H. H Barnes and N. T. Dinsmore; $50,000.——National Storage Battery Co., Troy, N. Y.; W. H. Hollister, Jr., E. G. Bernard and W. D. Weaver; $5,000.——Suburban Electric Co., Elizabeth, N. J.; to operate at New York City and Waterbury, Conn.; A. M. Young and J. K. Smith, of Waterbury, Conn., and Henry Hayes, of Newark, N. J.; $300,000.——Ellenville Electric Co., Ellenville, N. Y.; J. A. Kemp and P. B. Murray, of Delhi, N. Y., and E. D. Russell, of Ellenville; $30,000.——Neutral Storage Battery Co., Newark, N. J.; G. W. Harris, G. Huerstel and H. L. School, all of New York City; $300,000.

CONTRACT PRICES.

WELL.—Hillsboro, Tex.—The following bid has been received for sinking an artesian well: For the first 1,200 ft., $4,300; the next 300 ft., $1,050; the next 500 ft., $2,000. This is for a hole 5¼ ins. in diameter at the bottom, and includes iron casing of standard weight.

PAVING.—Dayton, O.—There were 100 bids received for the 111,100 sq. yds. of paving. The range of prices was as follows: Granite, $3 to $4.75; Medina, $2.70 to $4; asphalt, $2.72 to $3.25; asphalt block, $2.36 to $2.80; Hall wood block, $1.35 to $1.73; Hayden block, $1.23 to $1.88; brick, $1.12 to $1.61. No awards were made owing to an injunction.

SEWERS.—Lawrence, Kan.—The following proposals have been received, and the contract awarded to C. States. Mr Holland Wheeler is the engineer.

Quantities	...700 ft.	2,550 ft.	3,200 ft.	16	100 cu. yds.
Average depth	13 "	16 "	9 "	man-	rock
Diam. of pipe ...	15 ins.	12 ins.	12 ins.	holes, 10 ft.	excav.
	$	$	cts.	$	$
Christian States, Topeka, Kan.	0.78	0.72	48	42.50	3.00
Wm. Keyes, Kansas City, Mo....	0.80	0.80	52	42.50	2.50
H. L. Cook, Topeka, Kan.....	0.98	0.79	68	37.00	3.50
Wright, Zeigler & Dalton, Junction City, Kan.	1.19	1.08	79	52.25	3.50

MISCELLANEOUS.

BRICKS.—Columbus, O.—The Clerk of the Board of Public Works has been directed to advertise for bid for 2,000,000 hard-burned sewer brick to be delivered to the city during the present year.

JAIL.—Columbus, Ga.—The County Commissioners desire proposals until Feb. 2 for the construction of a jail for Muscogee County.

BUILDING.—Parkersburg, W. Va.—Bids for the erection and completion of the state building to be built on the Columbian Exposition grounds at Jackson Park, Chicago, in accordance with the plans of J. L. Silsbee, Architect, of Chicago, are called for by the Board of World's Fair Managers of West Virginia until Feb. 10. Mr. M. C. McKay is Secretary of the Board.

BONDS.—Birmingham, Ala.: $150,000 for public improvements.——Kent, O.; $80,000 for town improvements.——Colfax, Wash.; $60,000 for public improvements.——Toledo, O.; $74,000 for street improvements.

STEAM HEATING.—Proposals for heating apparatus for the post guard house at Fort Wingate, N. Mex., will be received until Feb. 8 by Major J.C. Lee, Chief Quartermaster U. S. A., Los Angeles, Cal.——The Commisioner of Indian Affairs, Washington, D. C., will receive bids until Feb. 8 for steam-heating plant for buildings at the Pine Ridge Agency, S. Dak.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Baldwin Locomotive Works, of Philadelphia, Pa., have orders for 20 four-cylinder compound engines for the Chicago & South Side Elevated Railway, which is described elsewhere in this issue; they will be tank engines, with four driving wheels under the boiler and a four-wheel trailing truck under the tank, and will weigh 28 tons. They have also orders from the Baltimore & Ohio for 13 ten-wheel, 10 consolidation, 12 six-wheel switching and 5 eight-wheel passenger engines; they are all simple engines, and will be built to drawings and specifications prepared by Mr. Geo. B. Hazlehurst, General Superintendent of Motive Power. The works built 918 engines during 1891. The Schenectady Locomotive Works, of Schenectady, N. Y., have a contract for 20 engines for the Chicago, St. Paul, Minneapolis & Omaha. The Pittsburg Locomotive Works, of Pittsburg, Pa., will build extensions to their shops.

CARS.—The Litchfield Car Works, of Litchfield, Ill., have an order for 1,000 freight cars, all equipped with the New York air brake, for the Eureka Transportation Co., of Kansas City, Mo. The Central Equipment Co., of Terre Haute, Ind., has been incorporated to build and lease cars; R. S. Cox, H. J. Baker and James Sneath; $50,000. The South Baltimore Car Co., of Baltimore, Md., is building 1,000 coal cars of 60,000 lbs. capacity for the George's Creek Coal & Iron Co.

ELECTRIC PUMP.—An electric pump has been put upon the market by Otis Brothers & Co., of New York. It is intended chiefly for household or office use, wherever it is possible to connect with electric lighting or power lines. It is automatic, as an electric switch cuts off the supply when the tank is full. It is recommended for cheapness in first cost, and maintenance, for noiselessness, cleanliness and safety. It can be applied to irrigation, the watering of live stock, operating of elevators, etc.

FURNACES.—Byram & Co., of Detroit, Mich., have shipped to the Leland Stanford, Jr., University, at Palo Alto, Cal., one of their Colliau cupola furnaces, made exclusively by this firm. Other foundry supplies went with it.

NEW COMPANIES.—Hill Double Lock Safety Switch Co., of Chicago, Ill.; J. J. Hill, W. H. M. Hill and D. H. Curtis; $250,000. Smith-Harris Pilot Switch Co., of Kittery, Me.; to manufacture switches for street railways, &c.; C. S. Collins, L. F. Harris and F. A. Eaton, all of Nashua, N. H.; $500,000. Chicago Vertical Safety Gate Co., of Chicago, Ill.; to manufacture crossing and bridge gates, etc.; E. W. Jackson and E. J. Mills; $500,000.

CURRENT PRICE LIST.

RAILS.—New York: $30 to $30.50; old rails, $21 to $21.25 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $22.50 to $23 for iron and $16.75 to $18 for steel. Chicago: $31; old rails, $22 to $22.35 for iron and $14.50 for steel.

TRACK MATERIALS.—New York; steel angle bars, 1.7 to 1.75 cts.; spikes, 2.1 to 2.2 cts.; track bolts, 2.65 to 2.9 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.65 cts. with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.8 cts. for iron and steel; spikes, 2.2 to 2.25 cts.; track bolts, 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57½ and 47½% on black and galvanized butt-welded; 67½ and 55% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $18. Pittsburg: $14 to $16. Chicago: $14.25 to $16.

LEAD.—New York: 4.15 to 4.2 cts. Chicago: 4.05 cts. St. Louis: 3.95 cts.

STRUCTURAL MATERIAL.—New York; beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.9 to 2.1 cts. for tank, 2.15 to 2.3 cts. for shell, 2.4 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles 1.9 to 2.1 cts.; tees, 2.25 to 2.4 cts.; universal iron mill plates, 1.85 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined bars, 1.75 to 1.8 cts.; steel plates, 1.85 to 2.5 cts. for tank, 2 to 2.1 cts. for shell, 2.25 to 2.5 cts. for flange, 3.5 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.05 to 2.15 cts.; tees, 2.1 cts.; universal plates, 2.12½ cts.; sheared steel plates, 2.2 to 2.25 cts.; steel plates, 2.4 to 2.6 cts. for tank, 2.75 to 3.5 cts. for shell, 3 to 3.25 cts. for flange.

Drainage Pump.

COMPTROLLER'S OFFICE,
CITY OF NEW ORLEANS,
NEW ORLEANS, Nov. 20, 1891.

Sealed proposals will be received at this office until the hour of 12 M., Thursday, Feb. 18, 1892, for the construction of a new drainage pump, in accordance with plans and specifications on file in the office of the City Engineer. Copies of plans and specifications will be forwarded by mail on request. A deposit of $200 will be required to accompany each bid. The city reserves the right to reject any and all bids. All in conformity with Ordinance No. 5,753, C. S., adopted Nov. 10, 1891.

OTTO THOMAN, Comptroller. 48-13t

U. S. ENGINEER OFFICE, BOSTON, Mass., Dec. 26, 1891. Sealed proposals, in triplicate, will be received at this office until noon of Jan. 26, 1892, for the delivery at Fort Warren, Boston Harbor, Mass., of 20,000 tons, more or less, of broken stone. Attention is invited to the acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. For full information apply to S. M. MANSFIELD, Lieut.-Col. of Engineers. 1 3t

Notice to Bridge Builders.

NEW BRUNSWICK, N. J., Jan. 9, 1892.

By a resolution passed Jan. 6 the Board of Freeholders of Middlesex County invited bridge builders or others desirous of competing for the construction of a stone arch bridge over the Raritan River at New Brunswick, N. J., to submit to them their plans for the proposed structure, said plans to be accompanied by specifications of materials to be used. The cost of the bridge must not exceed the appropriation, one hundred thousand dollars ($100,000).

Maps and cross sections of the site of the proposed bridge are on file, and information can be obtained at the office of Asher Atkinson, Engineer for the Board, 425 George St., New Brunswick, N. J. All plans are to be deposited with him on or before Tuesday, Feb. 16, 1892.

The Board of Freeholders reserve the right to reject any or all of the plans submitted.

3-1t HEZEKIAH WARNE, Director.

Commonwealth of Massachusetts.

METROPOLITAN SEWERAGE COMMISSIONERS—NOTICE TO CONTRACTORS:

Sealed bids for building Section 22 of the Metropolitan Sewerage System in Medford, in accordance with the form of contract and specifications to be furnished by the Board of Metropolitan Sewerage Commissioners, will be received by said board at its office, 93 Lincoln St., Boston, Mass., until 12 o'clock M. of SATURDAY, Jan. 30, 1892.

No bid will be received unless accompanied by a certified check for the sum of $1,000.

All bids must be made upon the blank forms furnished by the board.

Some other particulars are approximately as follows:

Section.	Length. Ft.	Average depth. Ft.	External diam. Ft.	Cu. yds. brick and other masonry.
22	6,075	21.5	5	2,200

Plans can be seen and specifications and forms of contract can be obtained at the above office.

Each bidder is required to make a statement indicating what sewer and similar work he has done, and to give references that will enable the board to judge of his business standing.

The board reserves the right to reject any and all bids.

HOSEA KINGMAN, TILLY HAYNES, ROBERT T. DAVIS, } Board of Metropolitan Sewerage Commissioners of Massachusetts.

HOWARD A. CARSON, Chief Engineer.

3-2t

Boiler and Heating Plant.

KANSAS CITY, Mo., Jan. 6, 1892.

Sealed proposals will be received at the office of the Board of Public Works of Kansas City, Mo., until Monday, Jan. 25, 1892, for furnishing the boiler and power plant and house heating apparatus for the new City Hall in accordance with the drawings and specifications, copies of which may be had at the office of the Superintendent of Buildings in said city. Each bid must be accompanied with a certified check for $500. For particulars address or call upon

L. G. MIDDAUGH,
3 1t Supt. of Buildings.

UTICA PIPE FOUNDRY CO.

CAST IRON PIPE AND SPECIALS FOR WATER AND GAS.
Also Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc.
CHAS. MILLAR & SON, Selling Agts., Utica, N. Y
Manufacturers of Lead Pipe and Plumbers' Materials.
Wholesale Eastern Agents Akron Vitrified Sewer Pipe.

MONTAGUE & COMPANY,
MANUFACTURERS
FIRE BRICK, SEWER PIPE,
DOUBLE STRENGTH
RAILROAD CULVERT PIPE.
CHATTANOOGA, TENN.

JOHN W. HARRISON, Pres. and Treas. THOS. HOWARD, Vice-Pres.
F. B. NICHOLS, 2d Vice-Pres. E. H. QUEEN, Sec'y. P. MCARTHUR, Supt.
HOWARD-HARRISON IRON COMPANY,
MANUFACTURERS OF
CAST IRON PIPE
FOR WATER-WORKS, GAS WORKS, CULVERTS.
Pipe and Pump Connections. Flexible Joints. Heavy Loam Castings.
Works at BESSEMER, ALA. Offices at BESSEMER and ST. LOUIS.

WRECK OF SCHOONER FLORENCE NOWELL. Engineer Office, U. S. Army Newport, R. I., Jan. 6th, 1892. To whom it may concern. Whereas navigation is obstructed and endanger d by the wreck of the schooner Florence Nowell lying about one mile W. S. W. from Pollock Rip Light Ship. Notice is hereby given to all persons interested in said vessel, her cargo and all other property therein, that if within thirty (30) days from the date of this advertisement, they shall not have signified to me their intention and taken preliminary steps to remove said wreck, etc., as soon as practicable, the same will be considered as abandoned and derelict and it will be removed by the United States under authority of law. Sealed proposals, in triplicate, for the removal of said wreck, will be received at this office until 12 o'clock, noon, on Monday, the 8th day of February, 1892 and then opened. The attention of bidders is invited to the acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals and to waive any informalities. Full information furnished on application. By authority of the Secretary of War: W. H. BIXBY, Captain of Engineers. 2-4t

SEALED PROPOSALS WILL BE RECEIVED at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M. on the 5th day of February, 1892, for all the labor and materials required for the trench excavation, concrete and stone foundations, stone masonry, cut stone and brick work of the basement and area walls, first floor and basement, beams and girders, basement columns, etc., for the U. S. Court House, Custom House and Post Office at Omaha, Nebraska, in accordance with the drawings and specification, copies of which may be had on application at this office or the office of the Superintendent.

Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal.

The Department will reject all bids received after the time herein stated for opening the same; also bids which do not comply strictly with all the requirements of this invitation.

Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Trench Excavations, Basement and Area Walls, Iron Beams, Columns, Etc., for the United States Court House, Custom House and Post Office at Omaha, Nebraska," and addressed to W. J. EDBROOKE, Supervising Architect. Jan. 8, 1892. 3-2t

SEALED PROPOSALS WILL BE RECEIVED at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock P. M. on the 10th day of February, 1892, for all the labor and materials required for putting in place complete the low pressure, return circulation steam heating and ventilating apparatus for the United States Post Office, etc., Building at Portsmouth, O., in accordance with drawings and specification, copies of which may be had on application at this office, or the office of the Superintendent at Portsmouth, O. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The Department will reject all bids received after the time herein stated for opening the same; also bids which do not comply strictly with all the requirements and meaning of this invitation, or upon any heating and ventilating apparatus not satisfactory to this department. Proposals must be inclosed in envelopes, sealed and marked "Proposal for the Low Pressure, Return Circulation, Steam Heating and Ventilating Apparatus for the U. S. Post Office Building at Portsmouth, O.," and addressed to W. J. EDBROOKE, Supervising Architect.

JAN. 12, 1892. 3-2t

Mechanicsville, N. Y., Water-Works.

NOTICE TO PIPE FOUNDERS:

SEALED PROPOSALS will be received for the manufacture and delivery of about 1,400 tons of CAST IRON PIPE and necessary specials by the undersigned, Water Commissioners of the Village of Mechanicsville, N. Y., at their office, up to 3 P. M. of Friday, Feb. 5, 1892, at which time they will be publicly opened.

Each proposal must be made upon the "form" furnished by the Commissioners.

The right to reject any or all bids is reserved by the Commissioners.

Plans, quantities, specifications and other information can be obtained from the Commissioners or the Engineer.

Address all communications to WM. B. NEILSON, Clerk of the Board of Water Commissioners.

JOHN C. GREENE, Pres.
WM. B. NEILSON, Clerk.
AMOS BRYAN, THOMAS H. SLAVIN, JOHN SHEEHAN, DANIEL RYAN, ALBERT PATRICK, } Comrs.

MECHANICSVILLE, N. Y., Jan. 9, 1892.
P. H. BAERMANN, Eng.,
3-3t No. 10 First St., Troy, N. Y.

SEALED PROPOSALS will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock p. m. on the 9th day of February, 1892 for all the labor and materials required for putting in place, complete, the low pressure, return circulation, steam heating and ventilating apparatus for the U. S. Court House and Post Office building at Statesville, N. C., in accordance with drawings and specification, copies of which may be had on application at this office or the office of the Custodian at Statesville, N. C. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The Department will reject all bids received after the time herein stated for opening the same; also bids which do not comply strictly with all the requirements and meaning of this invitation. Proposals must be enclosed in envelopes, sealed and marked, "Proposal for the Low Pressure Return Circulation, Steam Heating and Ventilating Apparatus for the U. S. Court House and Post Office Building at Statesville, N. C.," and addressed to W. J. EDBROOKE, Supervising Architect. Jan. 11, 1892. 3-2t

Vancouver Water-Works.

Sealed tenders will be received, addressed to "Thos. F. McGuigan, City Clerk, Vancouver, B. C.," up to 3 P. M., Monday Feb. 1, 1892, for about (1) 1,830 tons cast iron pipes and special castings. (2) 20 tons pig lead and pipe. (3) 100 hydrants and 200 valves. Specifications and particulars may be obtained on application to the undersigned, or the office of this paper.

The lowest or any tender not necessarily accepted. THOS. H. TRACY,
Vancouver, Dec. 16, 1891. City Engineer.

Proposals for Paving Streets.

SEALED PROPOSALS will be received at the office of the city auditor of the city of Dayton, until 12 o'clock, noon, Friday, February 5, 1892, for improving First street, from the west line of St. Clair street to the east line of Wilkinson street, estimate 11,000 square yards of paving.

Second street, from the west line of St. Clair street to the east line of Ludlow street, estimate 6,800 square yards of paving.

Third street, from the east line of Sears street to the river bridge, estimate 40,000 square yards of paving.

Fourth street, from the east line of Jefferson street to the east line of Ludlow street, estimate 4,500 square yards of paving.

Fifth street, from the railroad to the east line of Ludlow street, estimate 12,000 square yards of paving.

Main street, from the south line of Fifth street to the river bridge, estimate 25,000 square yards of paving.

Jefferson street, from the south line of Fifth street to the north line of First street, estimate 14,560 square yards of paving, by constructing necessary foundations, and making necessary excavation for same, furnishing and paving the roadway with granite block, Medina block, Hayden block, Hallwood block, asphalt, red brick or firebrick, furnishing and setting new curbs, constructing the necessary culverts, drains, catch-basins and retaining walls, in accordance with the plans and specifications on file in the office of the city civil engineer.

A deposit of five thousand ($5,000) dollars, to be left in the hands of the city auditor, will be required of each bidder as a guarantee that if any bid is accepted a contract will be entered into and performance thereof properly secured.

All bids must be made upon the printed forms, to be obtained at the office of the board of city commissioners, and inclosed in a sealed envelope directed to the board of city commissioners, Dayton, Ohio, and indorsed upon the outside of the envelope; "Proposals for Paving ——Street in the City of Dayton."

Each bid shall contain the full name of every person interested in the same.

Payments will be made monthly upon estimates furnished by the engineer on completed work, and 10 per cent. of each estimate will be retained until the completion of the work, according to the specifications. No money will be paid to the contractors until the engineer has certified that the work has been done according to contract.

The board reserves the right to reject any or all bids, or waive defects in bids in the interest of the city.

By direction of the board of city commissioners. W. E. HOOVEN, President.
C. A. HERBIG, City Auditor. 3-1t

Irrigation Tunnel.

Sealed proposals will be received by the directors of the Bear Valley Irrigation Company at Redlands, California, until March 1, 1892, for the construction of a tunnel about 6,600 ft. in length, through rock, in accordance with the plans and specifications on file in the office of the undersigned.

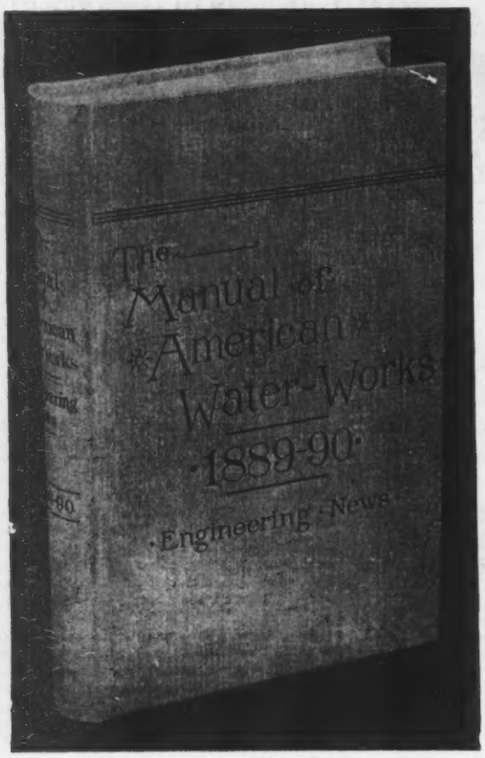
Bidders may propose to furnish their own power plant, or to use a complete power drilling, hauling and ventilating plant to be furnished by the company.

Each bid must be accompanied by a certified check for not less than 2 per cent. of the amount of the proposal.

The directors reserve the right to reject any or all proposals.

EDWARD M. BOGGS, Engineer,
Banning, California.

SEALED PROPOSALS will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until 2 o'clock p. m. on the 9th day of February, 1892, for all the labor and materials required for putting in place complete, the low-pressure, return circulation, steam heating and ventilating apparatus for the U. S. Custom House and Post Office building at Eastport, Maine, in accordance with the drawings and specification, copies of which may be had on application at this office or the office of the Superintendent at Eastport, Maine. Each bid must be accompanied by a certified check for a sum not less than 2% of the amount of the proposal. The Department will reject all bids received after the time herein stated for opening the same; also bids which do not comply strictly with all the requirements and meaning of this invitation. Proposals must be enclosed in envelopes, sealed and marked, "Proposal for the Low Pressure, Return Circulation, Steam Heating and Ventilating Apparatus for the U. S. Custom House and Post Office Building at Eastport, Maine," and addressed to W. J. EDBROOKE, Supervising Architect. 3-2t



THE Manual of American Water-Works FOR 1891

WILL BE READY NEXT WEEK.

This Issue of the Manual brings down by two years the information contained in the 1889–90 volume, a cut of which is shown at the left. It is prepared on the same general lines as previous issues, with exceptions and improvements noted below.

Over 2,800 Cities, Towns and Villages Included.

This Issue of the Manual describes water-works, mentions outside towns supplied, or towns having fire protection systems only, describes water supply systems (*i. e.*, those furnishing water for domestic use but not for fire protection), and describes projects of promise to the grand total of 2,850, as follows:

Water-works plants	2,132
Outside towns supplied	179
Water supply systems	131
Fire protection systems, about	50
Works projected, with fair prospects of construction	348
	2,840
Deduct duplicate works	29
Total cities, towns and villages included	2,811

This Issue of the Manual gives for many works statistics for several years, showing the miles of mains, number of taps, meters and hydrants, average daily consumption, cost, debt, expenses and revenue for each year.

This Issue of the Manual includes both the 1880 and 1890 census populations of the several towns.

This Issue of the Manual contains a list of all towns having works, arranged in order of population, in accordance with the 1890 census, with ownership, whether public or company, designated for each town. This list alone is worth double the price of the book to the man who is studying the problem of providing an adequate supply to a given town, or endeavoring to settle the vexed question of hydrant rental or water rates; for by turning to the above named list he can select as many towns as he wishes (if he doesn't wish more than there are) of about the same size as the town in question, and compare their works with his. If desirable he can separate these into public and private plants.

This Issue of the Manual, like all preceding ones, has an Introduction in which the contents of the body of the book are summarized and analyzed. The present Introduction treats of the following subjects:

Present Status—Showing for each state the number and cost of works, miles of mains, number of taps, meters and hydrants.

Growth in Numbers and Population Supplied—Showing number of works in each group of states at the end of each decade from 1801 to 1870, and at the end of each year from 1870 to 1890; also growth of populations supplied from 1880 to 1890.

Size of Towns Supplied and Projected Works—Showing by groups of states the size of the towns supplied in 1880 and 1890, and by states the number of projected works.

Management of Public Water-Works—Showing, in general, to what bodies public works are intrusted, how these bodies are raised to office and how long they hold office.

Consumption of Water and Use of Meters—Showing in detail consumption of water and use of meters in the 50 largest cities of the United States and how meters reduce consumption; also showing the same facts regarding all cities having 50 per cent. or more of taps metered. This is a question of great importance to every water-works man.

Ownership—Showing the relative growth of public and private water-works since 1800.

Franchises—Showing how cities and towns have protected or failed to protect their interests in granting franchises to water companies—provisions as to regulation of rates and purchase of works by the city, and length of franchises.

While a general description of each water-works is given in the 1891 Manual, much of the detailed descriptive matter in the last issue is omitted. *All new works, all changes and improvements since the last issue, and the latest obtainable statistics for both new and existing works are included in the volume advertised herewith.* But those wishing the exhaustive descriptions of many works given in the 1889-90 Manual, the illustrations of dams and reservoirs, the water rates of about 750 cities and the list of officials, engineers and contractors are referred to the 1889-90 issue.

PRICE OF 1891 MANUAL, DELIVERED, - - - $3.00.
" 1889-90 " " - - - - 3.00.

Orders filled only on receipt of price.

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